ERRATA

Commanding 21002

July 3, 2008

Errata Dated July 10, 2008

Added the following statement on the cover page: Final Version. This document has been reviewed and updated. No subsequent updates to this document are anticipated or required due to the approaching shuttle program closure.

USA005368
Rev. A

Space Program Operations Contract

Payload Communications/Orbiter Interface Unit Workbook PL COM/OIU 21002

Mission Operations Directorate

June 30, 2008

Errata July 10, 2008

Final Version
This document has been reviewed and updated.
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Contract NNJ06VA01C

United Space Alliance

USA005368
Rev. A

Payload Communications/Orbiter Interface Unit Workbook
PL COM/OIU 21002

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REVISION LOG

Rev. letter	Change no.	Description	Date
Basic		USA number assigned; supersedes TD137	02/28/2003
A		Changed syntax, grammar, formatting, USA logo, and contract statement. Removed evaluation sheet	06/30/2008
	Errata	Final Version statement added to cover page	07/10/2008

TECHNICAL SUPPORT

Subject Matter Experts

Don Carson, Laura Vincent

LIST OF EFFECTIVE PAGES

The current status of all pages in this document is shown below.

Page no.	Change no.
Foreword	Rev. A
Preface	Rev. A
i - v	Rev. A
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3-1 – 3-6	Rev. A
4-1 – 4-6	Rev. A
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A-1 – A-3	Rev. A
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FOREWORD

The content of this document was provided by the Shuttle Communications Training Department, Flight Operations Group, Mission Operations Directorate (MOD), Lyndon B. Johnson Space Center (JSC), National Aeronautics and Space Administration (NASA). Any questions or any recommendations concerning the technical content of this document should be directed to the book manager, Laura Vincent, DS25, 281-244-7414.

This material is for training purposes only and should not be used as a source of operational data. All numerical data, displays, and checklist references are intended only as examples. Consult the applicable Certification Plan outlined in your Flight Operations Support Personnel Training Guide (Blue Book) to determine any prerequisites before using this document. This training package should be studied before attending any classroom session or lesson for which this is a prerequisite.

PREFACE

This text covers functional and operational areas of the orbiter Payload Communication (PL COMM) System. There are no Flight Data File (FDF) procedures in this text. Instead, it is meant to give the reader a background understanding of the system in order to be able to use the FDF.

Sometimes the workbook does overlap into other communication areas. Some questions may be answered by referring to other communication systems workbooks.

Section 1 is the Payload Communications (PL COMM) Overview, covering the command and telemetry paths, the Payload Umbilical (PL UMB) and system redundancy. The PL UMB is the patch panel used to connect the PL COMM system to attached payloads. The next four sections cover the individual payload communication system Line Replaceable Units (LRUs). **Section 2** is the Payload Signal Processor (PSP) section, which covers PSP operation and explains how the PSP makes command and telemetry data compatible for various payloads. **Section 3** is the Payload Interrogator (PI) section; here are details about the operation of the PL COMM radio frequency transmitter/receiver unit. **Section 4** covers Payload Data Interleaver (PDI) operation and data flow. **Section 5** is the Decommutator Format Load Procedures section, covering the PL COMM FDF for PDI loads. **Section 6** is the Decommutator Error Indication section, including the Fault Detection Annunciation (FDA) scheme in the Systems Management (SM) software. **Section 7** is the Malfunction Points section, where the different types of PL COMM malfunctions and their solutions are discussed. **Section 8** is the Orbiter Interface Unit (OIU) section; the OIU is the LRU that interfaces with MS 1553 B devices.

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1.0 PAYLOAD COMMUNICATIONS SYSTEM OVERVIEW

1.1 OBJECTIVES

After completing this section, the student will be able to

a. Trace both the Radio Frequency (RF) and hardline command route to the corresponding payload

b. Trace both the RF and hardline telemetry route to the ground

c. Understand the basic function of each payload Line Replaceable Unit (LRU) in the command path

d. Understand the basic function of each payload LRU in the telemetry path

1.2 INTRODUCTION

The payload communication system supports both hardline and RF shuttle payloads. The payload communication system processes payload commands and payload telemetry for up to five hardline payloads and provides many RF channels to accommodate RF payloads of different frequencies. This system is used to activate, check out, and deactivate attached and detached payloads.

1.3 COMMAND OVERVIEW

Payload commands may be uplinked to the orbiter through the S-band or the Ku-band system. Hardline or RF commanding is generally done by the orbiter crew through the execution of ITEM entries on payload specific displays. Payload commanding may also be initiated from the Mission Control Center (MCC) (or some other facility supporting a payload) through the payload communications system by the way of the orbiter S-band or Ku-band communications system. See Figure 1-1. The uplink is sent directly to the network signal processor (NSP). The NSP strips off the voice and sends it to the Audio Central Control Unit (ACCU); the commands travel on through the Flight Forward (FF) Multiplexer/Demultiplexers (MDMs) to the Guidance Navigation and Control (GNC) General Purpose Computer (GPC) (FF 1 is hardwired to NSP 1 and FF 3 is hardwired to NSP 2). The GNC GPC will communicate the command to the Systems Management (SM) GPC through the Intercomputer Communications bus (ICC). The SM GPC routes the command through the Payload Forward (PF) 1 or 2 MDM to the Payload Signal Processor (PSP) 1 or 2.

The PSP processes commands and modulates them onto a subcarrier. The PSP command output function determines whether the commands need to be routed to the Payload Umbilical (PL UMB) or the Payload Interrogator (PI). The PL UMB routes commands to one of five hardline payloads and the PI will modulate the command data onto a main carrier and transmit it to the RF payload.

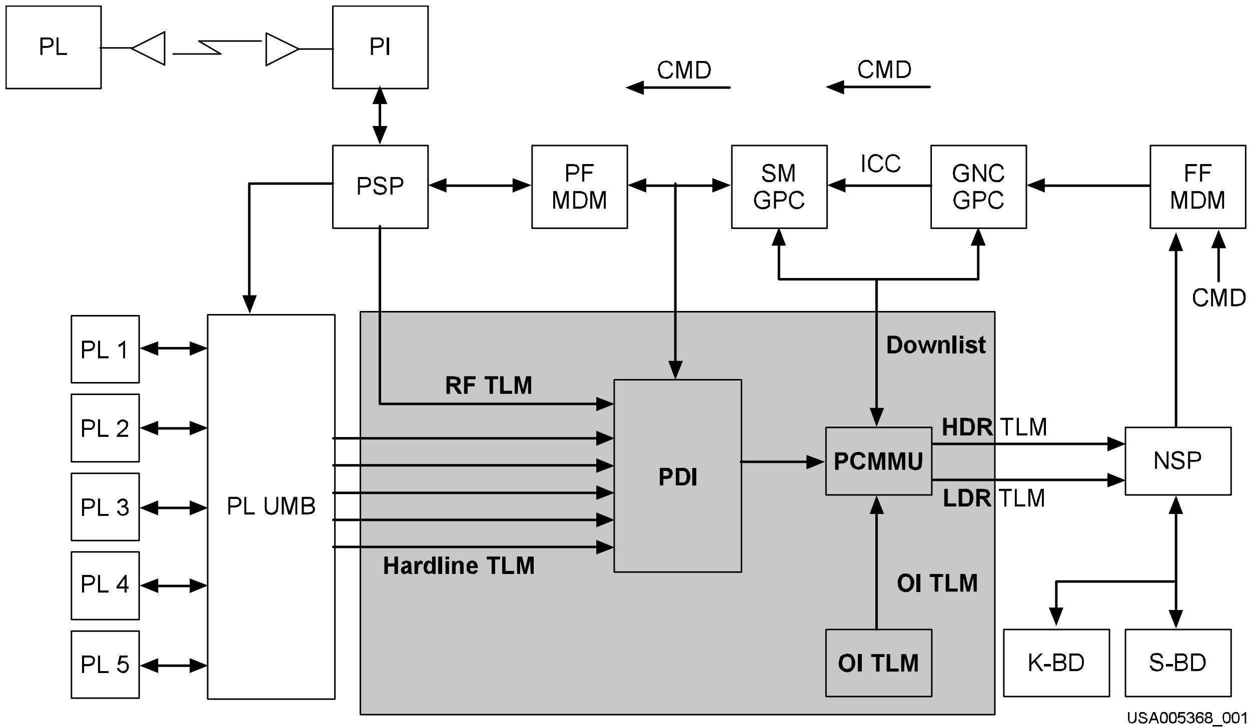


Figure 1-1. Payload command overview

1.4 TELEMETRY OVERVIEW

For RF payloads (Figure 1-2), telemetry is first demodulated from the main carrier by the PI, and then sent to the PSP. The PSP demodulates the payload telemetry from the subcarrier and achieves bit and frame sync. The RF telemetry from the PSP and hardline telemetry from the PL UMB are sent to the Payload Data Interleaver (PDI) where it is formatted into one output stream. The Pulse Code Modulation Master Unit (PCMMU) retrieves telemetry from the PDI using demand/response signals. The PCMMU formats the payload telemetry with Operational Instrumentation (OI) telemetry and GPC downlist into a High Data Rate (HDR) and a Low Data Rate (LDR) output stream. The PCMMU sends the HDR and LDR telemetry streams to the NSP. The NSP multiplexes one of the PCMMU telemetry streams with the downlink voice (Air-to-Ground (A/G) 1 and/or 2) then sends the HDR/LDR stream to the S-band and Ku-band system for transmission to the ground. The PDI also processes payload telemetry for onboard display. The telemetry is routed through the PCMMU to the SM GPC display.

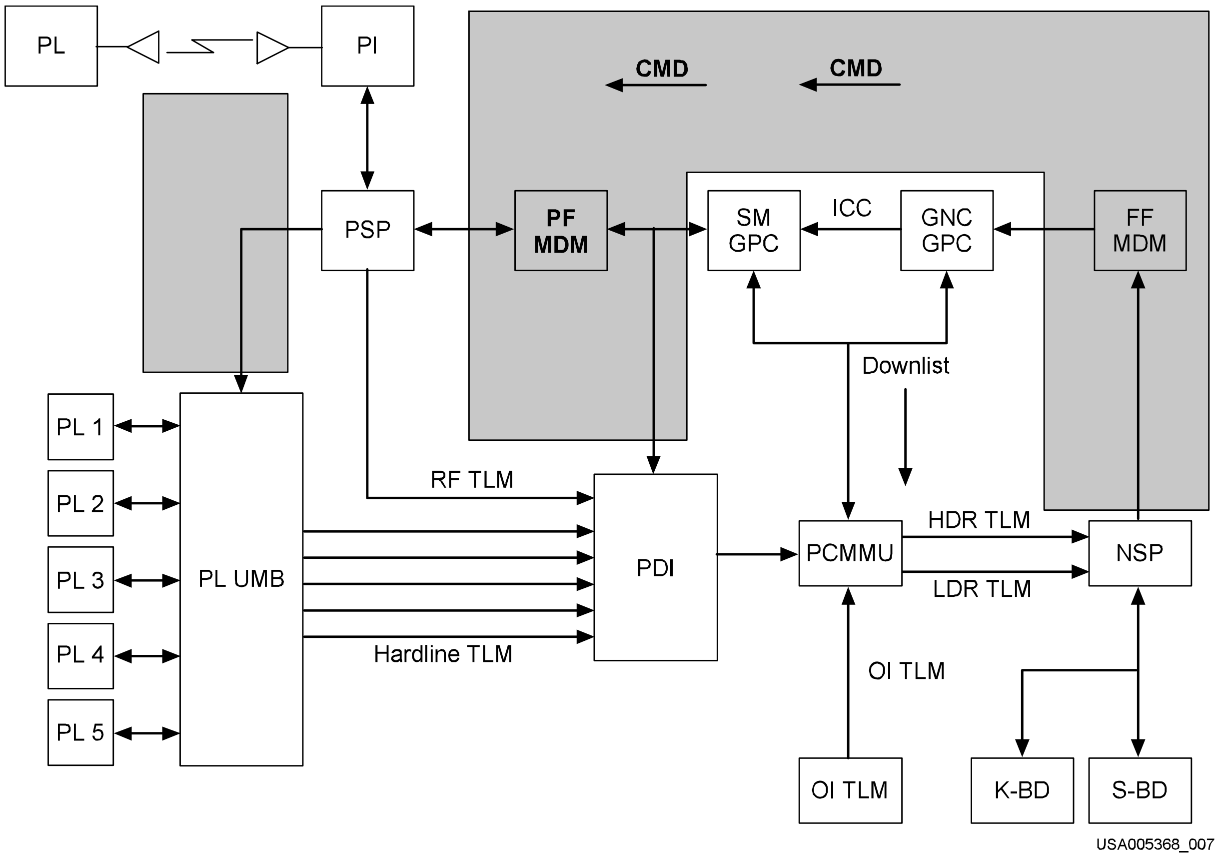


Figure 1-2. Payload telemetry overview

1.5 REDUNDANCY

The payload communication system is composed of redundant units. Both the PI and the PSP have alternate units. PI 1 is hardwired to PSP 1, which is connected to the Payload Forward Multiplexer/Demultiplexer 1 (PF MDM). PI 2 is hardwired to PSP 2, which is connected to the PF MDM 2. The systems are not cross-strappable (i.e., PSP 1 cannot work with PI 2). Likewise, the PF MDM 1 cannot work with String 2 (Figure 1-3).

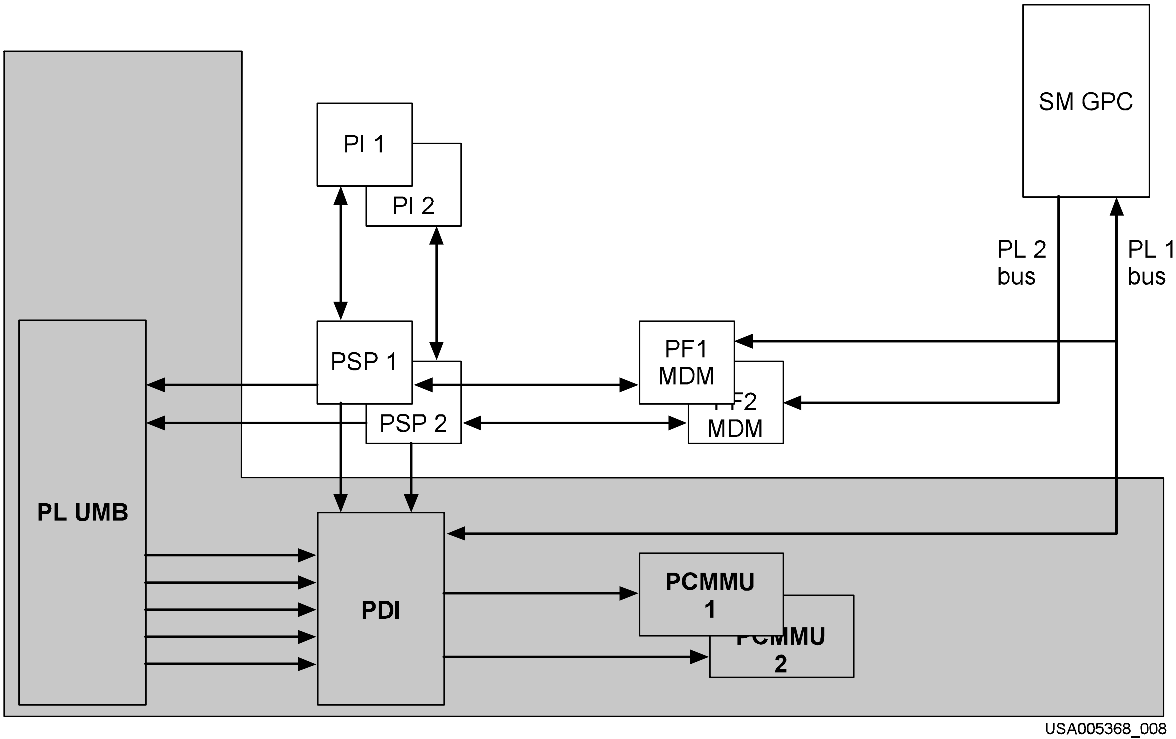


Figure 1-3. Redundancy overview

Questions

1. Commands may be uplinked from the ground to the orbiter through the __________ or __________ system.

   a. PI, PDI

   b. PSP, PL UMB

   c. Ku-band, S-band

   d. SM GPC, PSP

2. The _________ process and modulates commands onto a subcarrier for hardline and RF payloads.

   a. PSP

   b. PCMMU

   c. PDI

   d. SM GPC

3. The __________ command output function makes the selection between the RF or the hardline command path.

   a. PI

   b. PSP

   c. PDI

   d. PCMMU

4. Telemetry is first demodulated from the main carrier by the __________.

   a. PI

   b. PCMMU

   c. PDI

5. The hardline command path is

   a. NSP to FF MDM to GPC to PF MDM to PSP to PL UMB to PL

   b. NSP to FF MDM to GPC to PF MDM to PSP to PI to PL

   c. RF PL to PI to PSP to PDI to PCMMU

   d. HL PL to PL UMB to PDI to PCMMU

6. The RF command path is

   a. NSP to FF MDM to GPC to PF MDM to PSP to PL UMB to PL

   b. NSP to FF MDM to GPC to PF MDM to PSP to PI TO PL

   c. RF PL to PI to PSP to PSI to PCMMU

   d. HL PL to PL UMB to PDI to PCMMU

7. The RF telemetry path is

   a. NSP to FF MDM to GPC to PF MDM to PSP to PL UMB

   b. NSP to FF MDM to GPC to PF MDM to PSP to PI

   c. PL to PI to PSP to PDI to PCMMU

   d. PL to PL UMB to PDI to PCMMU

2.0 PAYLOAD SIGNAL PROCESSOR

2.1 OBJECTIVES

After completing this section, the student will be able to

a. Explain the two ways the PSP can route commands

b. Explain how to establish SM to PSP Input/Output (I/O) interface through the PF MDM and why this is needed

c. Identify the data path to SM SPEC 62 for PSP status

d. Explain the purpose of the PSP configuration message

e. Identify two ways for a configuration message to be loaded

2.2 INTRODUCTION

The PSP is a multimode processor that provides modulation/demodulation bit and frame synchronization of payload telemetry data and transmits the proper frame synchronized telemetry data to the PDI. It also modulates payload command data and translates the modulated signal to the PI or the payload umbilical. The PSP makes commands and telemetry compatible with the different types of payloads.

2.3 INTERFACES

The PSP interfaces with the PI. The PSP accepts payload telemetry from the PI and delivers commands to the PI and to the PL UMB. The PSP receives all its payload commands through the PF MDM from the SM GPC, and PSP status is sent to the SM GPC through the PF MDM. Part of the PSP status data are displayed on SPEC 62, and PSP I/O RESET (through the PF MDM) is established on SPEC 62. The GCIL interface with the PSP allows the PSP configuration from MCC command or crew panel selections.

2.4 CONFIGURATION MESSAGE

The PSP must be able to process different types of data streams because it communicates with different payloads. Therefore, the PSP must be loaded with a configuration message in order to process the commands and telemetry. The configuration message prepares the PSP for data types, data rates, sync words, etc.; for RF telemetry streams and RF or hardline commands. A configuration message must precede the payload command.

The PSP interface to the SM GPC and the PF MDM must be active before a configuration message may be loaded. This PSP I/O RESET can be performed on SM SPEC 62 with an ITEM 6 EXEC or an ITEM 7 EXEC (Figure 2-1). The ITEM 6 EXEC establishes I/O with PSP 1 and the ITEM 7 EXEC with PSP 2. The SM GPC sends

both the configuration message and the command words through the PF MDM to the PSP (Figure 2-1). There are five prestored configuration messages in the SM GPC; however, the ground may build any configuration message needed and load it into one of the prestored configuration locations. A prestored configuration message may be loaded by an item execution on a payload-specific display (if available) or an uplink command load.

The PSP will not process commands or telemetry correctly without the proper configuration message. For RF payloads, if there is no configuration message, the PSP BIT and FRAME SYNC on SPEC 62 will read NO. The PSP BIT and FRAME SYNC on SPEC 62 represent the PSP lock on the RF telemetry stream. A PSP power cycle would cause the configuration message to disappear.

The configuration message consists of the following information:

a. Reinitialize (yes or no)

b. Number of PL command words (maximum of 32 words)

c. PL command data rate

d. PL command data type

e. PL umbilical selection (1 through 5)

f. Command idle pattern (tone)

g. Telemetry data rate

h. Telemetry data type

i. Telemetry frame length

j. Frame sync word length

k. Telemetry frame sync word

l. Spares

2.5 PSP COMMAND PATH

Now that the I/O and the configuration message have the PSP is ready to accept and process (route) the 1Mbps commands from the SM GPC and the PF MDM. Once the commands are accepted and validated by the PSP, the commands are stored in a command buffer, modulated onto a 16-kHz subcarrier, and sent as an output at the data rate specified in the configuration message.

The PSP must be configured to send the command signal to the PI or to one of the hardline payloads. This can be accomplished by using the PSP CMD OUTPUT switch on panel A1L or by uplink command. INTRG represents the PI path and UMB represents the hardline UMB path. If the hardline UMB position is chosen, the specific umbilical (1 through 5) is selected in the configuration message.

When there are no commands being processed, some payloads require an ‘idle pattern’ to be transmitted from the PSP (Figure 2-1). This idle pattern is processed just the same as a command in order to keep the RF receiver on the payload from going into a standby (non receive) mode. Most payloads do not need an idle pattern, and it can be disabled.

2.6 PSP TELEMETRY PATH

The PSP receives a modulated signal on a 1.024 MHz subcarrier from the PI. The PSP demodulates the subcarrier and achieves bit and frame synchronization (sync). If the loaded configuration message does not match the telemetry stream, bit and frame sync will not be achieved, the SPEC 62 PSP BIT and FRAME SYNC will read NO and the PSP will not output the telemetry stream to the PDI. Once frame sync is achieved, the PSP sends the telemetry and a clock timing signal to the PDI. For hardline payloads the PSP BIT and FRAME Sync logic is bypassed, therefore SPEC 62 will read NO.

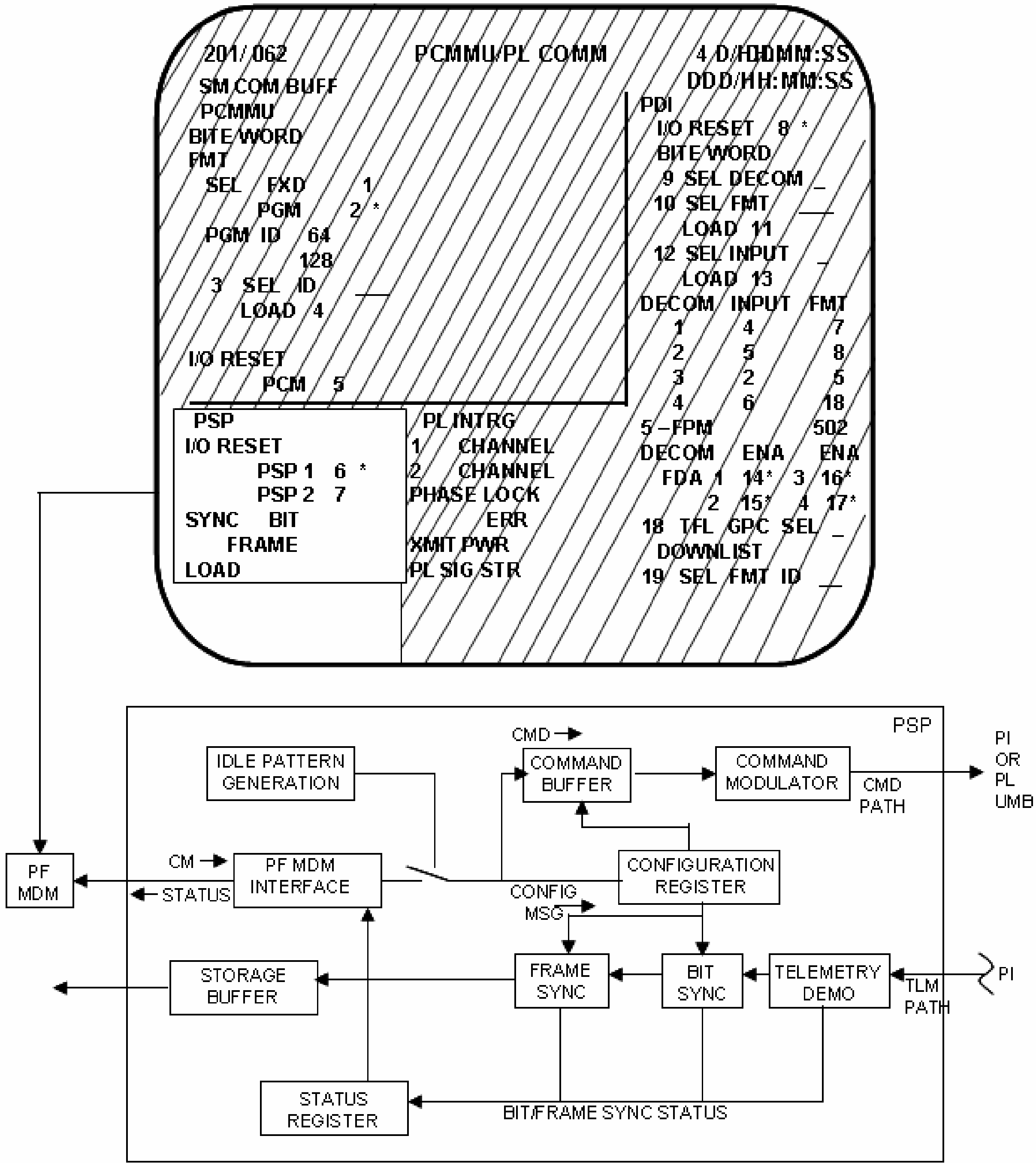


Figure 2-1. Payload signal processor

2.7 PSP STATUS

The PSP BIT and FRAME SYNC status and I/O status are sent through the PF MDM to SM SPEC 62 (Figure 2-2). In order for this interface to process status data, I/O reset must be established between the SM GPC and the PSP in use. The I/O reset is established on SM SPEC 62 for PSP 1 (ITEM 6 EXEC) or PSP 2 (ITEM 7 EXEC). The choice between ITEM 6 or 7 depends on which PSP is being used. If the PSP does not

respond to the SM GPC with status, the SM GPC will bypass the PSP and will annunciate an SM alert.

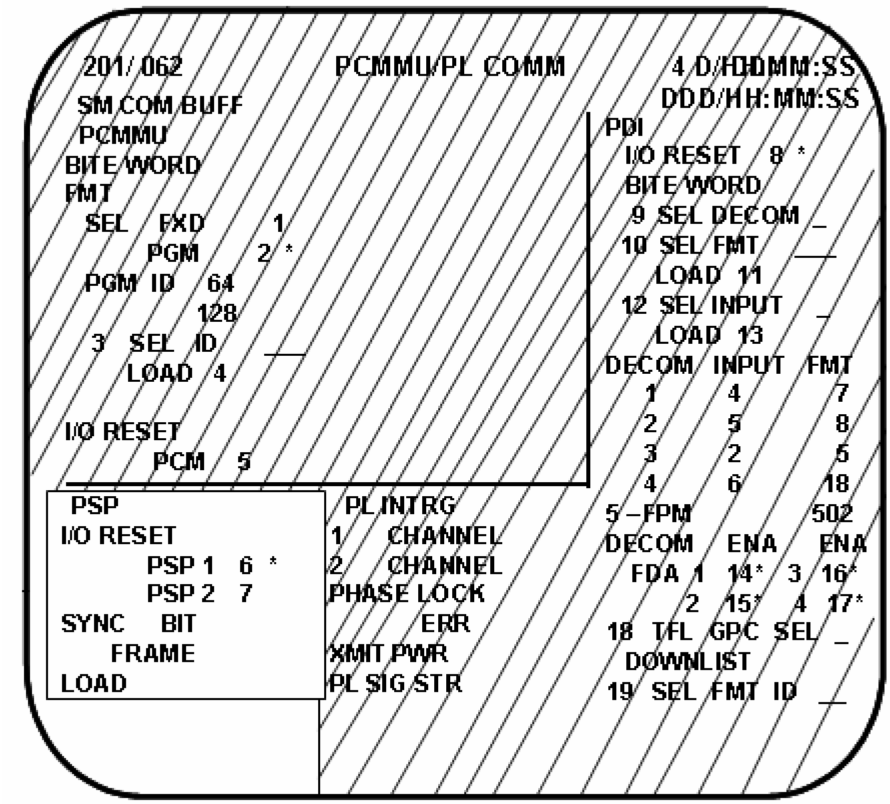


Figure 2-2. SPEC 62 - PSP field

PSP status is also sent through the OI MDM (OF2) to the PCMMU (Figure 2-3). From the PCMMU, the status is downlinked to the ground through the normal telemetry route.

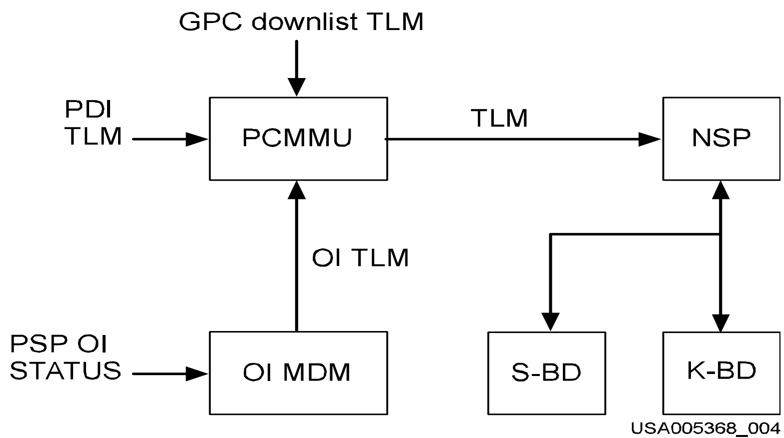


Figure 2-3. PSP OI MDM downlink

2.8 PSP POWER SWITCHES

The POWER SYSTEM switch for PSP panel A1L (Figure 2-4) is a three-position switch that is used to select the system that is to be powered on. These positions are 1, OFF, and 2. The second switch, the POWER SELECT switch, is used to power on the PSP and the PI independently or together. These positions are INTRG, BOTH and PSP. When BOTH is selected, both the PI and PSP will be powered. When PSP is selected, only the PSP will be powered. When INTRG is selected, only the PI will be powered, SPEC 62 PSP BIT and FRAME SYNC will disappear, and PSP I/O RESET will have an "M" by the PSP (Figure 2-4). The PSP CMD OUTPUT switch is a two-position switch that is used to route the commands from the PSP to the payload. These positions are INTRG for PI RF payloads and PL UMB for hardline payloads.

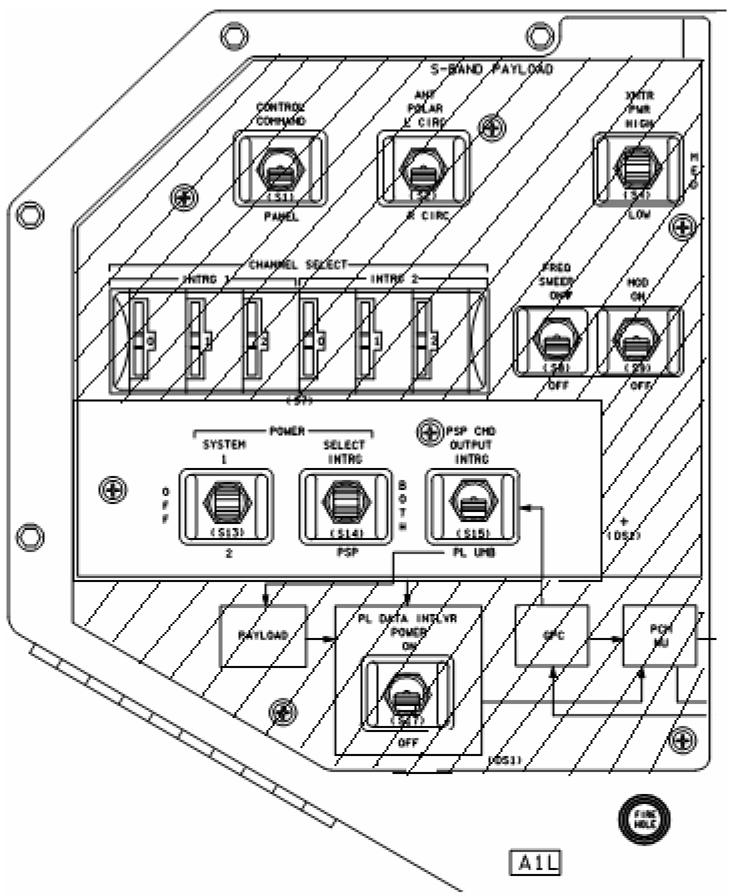


Figure 2-4. Panel A1L

Questions

1. I/O must be reestablished and the __________ __________must be reloaded in order to regain use of the PSP after a power cycle.

2. If I/O was established, but the configuration message was lost with RF PL, would SPEC 62 show “YES” for BIT and FRAME SYNC? (yes/no)

3. The PSP can load a configuration message without having I/O established with the SM GPC? (yes/no)

4. PSP BIT and FRAME SYNC data are sent to SM SPEC 62 through the _______ ________.

5. If the SELECT switch on panel A1L is moved from BOTH to the INTRG position, the LRU that gets turned OFF is the _________ (assume SYSTEM switch is on 1 and GCIL control switch is in Panel).

6. If the PSP power is turned off, the BIT and FRAME SYNC on SPEC 62 will

   a. read YES

   b. read NO

   c. be blank

   d. read OFF

7. The PSP CMD OUTPUT switch will direct commands to:

   a. The PI or PL UMB

   b. The PI or PDI

   c. The PL UMB or PCMMU

3.0 PAYLOAD INTERROGATOR

3.1 OBJECTIVES

After completing this section, the student will be able to

a. Understand what is changed when the PI channel thumbwheels are changed

b. Recognize which orbiter communications systems may interface with PI operation

c. Identify the function of the panel A1L switches

d. Identify how panel A1L switch throws affect SPEC 62

e. Explain where the PI receives and routes both telemetry and commanding

3.2 INTRODUCTION

The Payload Interrogator (PI) is a transmitter/receiver unit used to communicate with RF payloads. The PI transmits commands and receives telemetry from the RF payload. The PI operates in a full-duplex mode. Full duplex means it can process command and telemetry data simultaneously on two different carrier frequencies.

3.3 INTERFACES

The PI interfaces with the Payload Antenna Switch to determine which RF pattern, either Left Hand Circular Polarization (LHCP) or Right HCP (RHCP) will be used since both XMIT (telemetry) and RCV (commanding) support for RF Payloads. The PI has a payload telemetry interface to the PSP. The PI also receives commands from the PSP. The PI interfaces with the Ku Signal Processor (KuSP) for bent pipe telemetry transmission to the ground. The PI interfaces with the Ground Command Interface Logic (GCIL), which allows the PI configuration to be controlled by panel switches or by command from MCC. The PI interfaces with a meter on panel A1U, for signal strength. The PI interfaces with the OI MDM to provide PI status for display to the crew and downlink for MCC.

3.4 PI COMMAND PATH

3.4.1 Transmitter Modulator

From the PSP, PI commands received are modulated onto the carrier frequency in the Transmitter Modulator (XMTR MOD) block, as shown in Figure 3-1. Crew-members may turn command (or idle pattern) modulation ON or OFF with the MOD switch on S-band payload panel A1L. The crew will take the MOD switch to the OFF position during signal acquisition; this prevents the payload receiver from locking onto a PI sideband frequency. After the payload receiver locks onto the carrier frequency, the crew will apply command modulation by taking the MOD switch to ON. Some payload receivers are designed to acquire a modulated signal. In this case, the crewmember

will leave MOD ON when acquiring a command link to the payload. If it appears that the payload is locked onto the forward link, but commands are not being received, false lock may be the cause. The crew may try to reacquire the forward link by using the FREQ SWEEP switch.

The carrier frequency can be modified with the momentary FREQ SWEEP switch on panel A1L (Figure 3-1). By holding the switch in the ON position, the PI frequency sweeps through a range that is centered about the carrier frequency. The sweep function helps a payload receiver, with a fixed frequency range lock onto the PI transmitted signal. PI operations requiring use of the FREQ SWEEP or MOD switches are located in payload-specific Flight Data File (FDF).

The transmitter and receive carrier frequencies can be selected by channel selection thumbwheels on S-band payload panel A1L or via uplink command. . In most cases, when a channel is selected, both the transmit carrier and receive carrier frequencies are selected (Figure 3-1). For example, channel 301 is composed of the two frequencies: 2237.5 MHz (XMIT frequency) and 2060.4 MHz Receive (RCV) frequency). However, some channels are designed to select only a transmit carrier or receive carrier frequency. The channel selected for PI 1 or 2 is displayed on SPEC 62 when the PI is active. Flight-specific channels are located in payload-specific FDF.

Note: There may be S-band payload frequency restrictions to avoid interference with the orbiter S-band frequency modulation (FM) or S-band phase modulation (PM) systems.

3.4.2 Power Amplifier

After the signal has been modulated with commands (XMTR MOD block), it is boosted by the power amplifier (Figure 3-1). The PI has three transmitter power levels that are selectable by way of the S-band payload panel on A1L. The three-position XMTR PWR switch may select a HIGH, MED, or LOW power level. The actual power level on SM SPEC 62 is displayed beside XMIT PWR (Figure 3-1). The requirements for PI transmitter power levels vary from mission to mission, and the crew or MCC selects the power level as specified in the payload operations FDF.

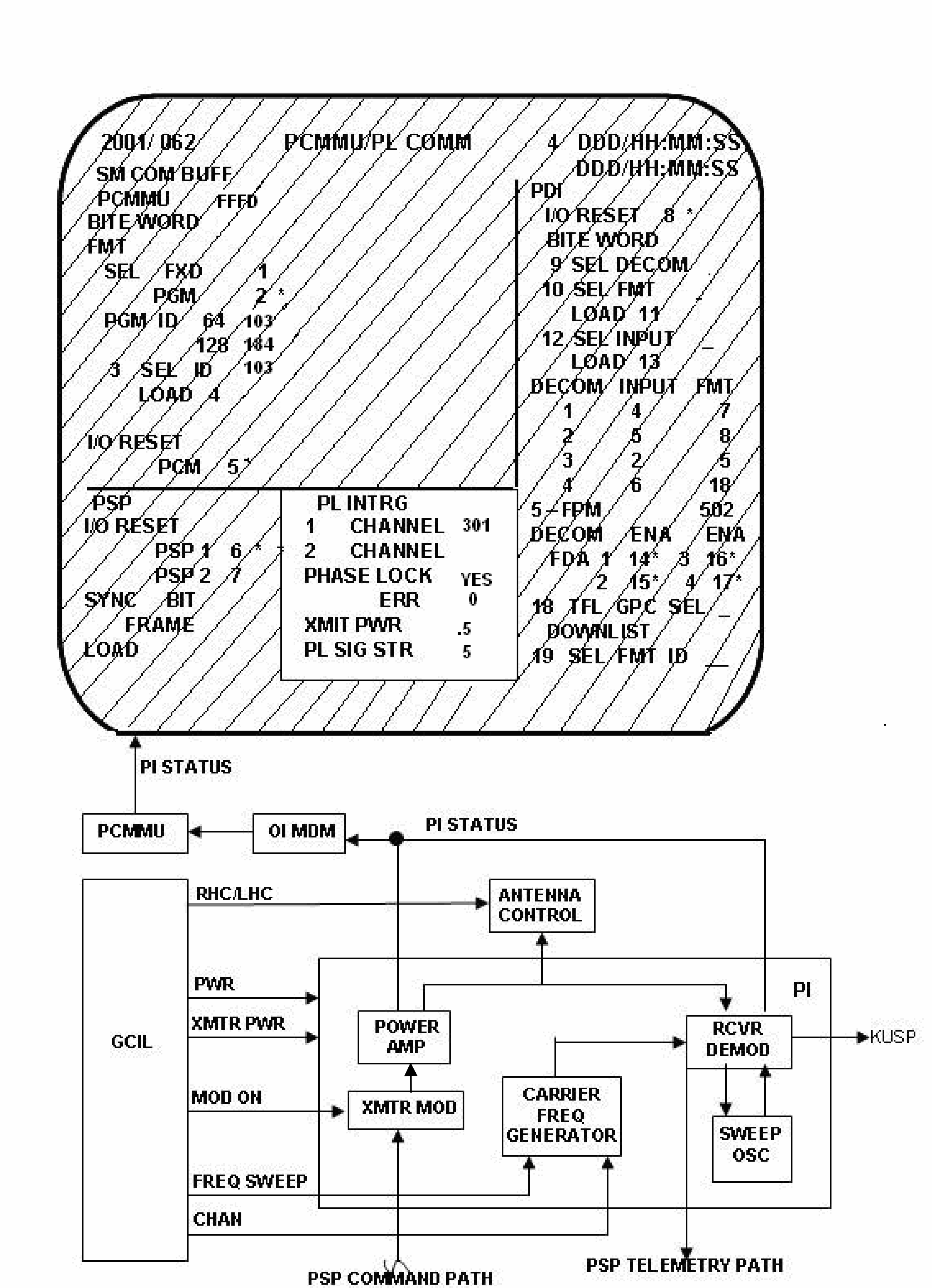


Figure 3-1. Payload interrogator

3.4.3 Antenna Control

The ANTENNA POLAR selects the rotational direction of the transmitted signal. It may be configured to process Right-Hand-Circular (RHC) or Left-Hand-Circular (LHC) polarity. The LHC/RHC switch is located on the S-band payload panel A1L. The selection must always match the RF payload antenna polarity; otherwise, the signal will be degraded, preventing carrier lock. The antenna control is specified in the payload operations FDF.

3.5 PI TELEMETRY PATH

3.5.1 Antenna Control

The telemetry signal is received by the antenna and goes to the antenna control (Figure 3-1). If the polarity of the received signal matches the payload antenna polarity (LHC or RHC), then the phase lock is achieved. The chosen polarity for the telemetry signal is the same as for the command signal, and is determined by the payload.

3.5.2 Receiver Demodulator

Next, the signal goes to the receiver demodulator (RCVR DEMOD) (Figure 3-1). An internal oscillator in the demodulator will sweep the frequency range automatically during payload signal acquisition. The demodulator will lock onto the carrier alone or it will lock onto a modulated signal. Once it has locked, it strips off the subcarrier and the payload telemetry from the main carrier and sends them to the PSP. Demodulator PHASE LOCK and PL SIG STR are displayed on SPEC 62. If the payload transmitter/receiver power is turned off or not transmitting, the PHASE LOCK will read NO and the PL SIG STR will read 0 on SM SPEC 62 or A1U meter when in the payload position.

3.5.3 Ku-Band Signal Processor Downlink

If the PSP cannot process the payload telemetry stream, there is an alternate method for getting the data to ground (Figure 3-1). If the PI is ON and receiving a signal, then the unprocessed telemetry is available to the KuSP for downlink. Channel 2 or 3 of the KuSP must have PL INTRG selected on panel A1U (or via UL CMD) in order to transmit the unprocessed telemetry to ground. This technique is referred to as "bent-pipe" processing. The PSP can only process five data types and if the payload telemetry rate is not one of the five, then bent pipe is used. One payload that uses the bent-pipe mode is the Hubble Space Telescope.

3.6 PI STATUS

PI status is sent through the OI MDM (OF2) to the PCMMU (Figure 3-2). The PCMMU sends this telemetry to the ground (Figure 3-3). The status consists of the PI channel selected (000-999), the phase-lock status (yes/no), tracking error (kiloHertz), transmitter power (watts), and payload signal strength (volts). If the OI MDM (OF2) power or the PCMMU power is lost, then the PI field will show a column of Ms beside static data.

Also, if the CONTROL switch on panel A1L is in the PANEL position, the SPEC 62 PI field will display the channel selected and the transmitter power selected on panel A1L.

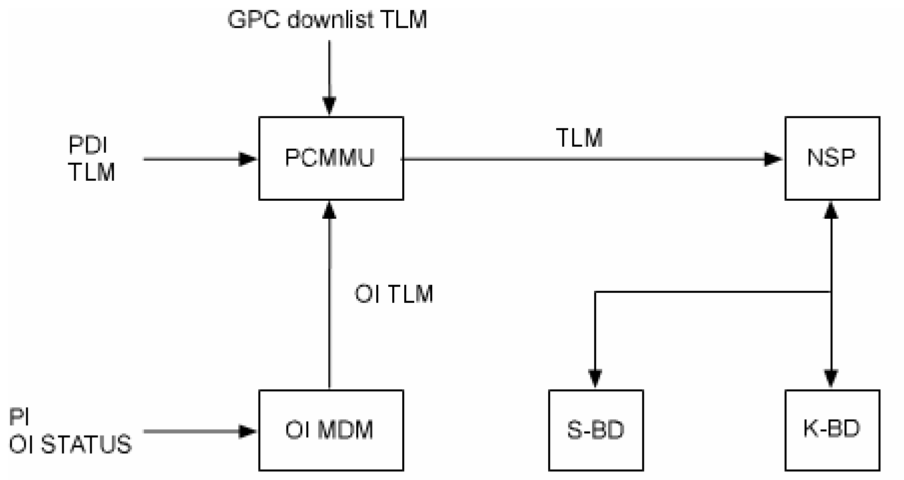


Figure 3-2. PI OI MDM downlink

3.7 PI POWER SWITCHES

The SELECT switch on panel A1L can power the PI and the PSP in the BOTH position or only the PI in the INTRG position. If the SELECT switch is turned to PSP, then the PI power will be turned OFF. If the PI power is turned OFF, the PI fields on SPEC 62 will be blank (no Ms). The SYSTEM power switch determines which PI and/or PSP unit is being powered (1 or 2).

Questions

1. The PHASE LOCK field on SPEC 62 will _________ if the payload transmitter/receiver unit is locked with an RF PL.

   a. read NO

   b. read YES

   c. be blank

2. If the PI power is turned OFF, the PI status field on SPEC 62 will __________.

   a. be blank

   b. have Ms

   c. read YES

3. The _____ _____ switch on panel A1L will help a fixed payload receiver lock onto the PI carrier signal.

4. The FREQ SWEEP switch on panel A1L may help the PI receiver lock onto the payload carrier signal only if the payload transmitter/receiver unit is in the _________ mode.

5. If MOD is turned off on panel A1L, then the payload receiver will still be able to achieve BIT SYNC (yes/no) and LOCK. (yes/no)

Match the letters with the numbers:

1. “BOTH” ______	a. command or idle pattern modulation data.
2. “INTRG”	b. changing carrier frequency
3. “FREQ SWEEP” _____	c. 000-999
4. “MOD” _____	d. PI on
5. “CHANNEL” _____	e. LO, MED, HI
6. “XMTR PWR”	f. PSP on and PI on

4.0 PAYLOAD DATA INTERLEAVER

4.1 OBJECTIVES

After completing this section, the student will be able to

a. Explain what a Decommutator Format Load (DFL) does

b. Explain what the Fetch Pointer Memory (FPM) does with the PDI toggle buffer

c. Explain why the Telemetry Format Load (TFL) must be compatible with the DFL

d. Locate DFL/FPM configurations in the FDF

e. Explain the purpose of the SM to the PDI PL bus interface

f. Identify which PDI input is reserved for the PSP/PI

4.2 INTRODUCTION

The PDI interfaces the hardline and RF payload telemetry to the downlink telemetry stream and to the GPC display. The PDI takes in data and stores it. The programmable instructions in the PDI will format the RF and hardline telemetry into a combined payload telemetry stream upon request by the PCMMU.

The PDI is composed of five areas: the switch matrix, the decommutator, the Random Access Memory (RAM), the toggle buffers, and the FPM. All of these areas are discussed in the following sections.

4.3 INTERFACES

The PDI interfaces the five hardline payloads for telemetry through the PL UMB. The PDI also interfaces the PSP for RF telemetry. The PDI interfaces with both PCMMUs. The PDI outputs a payload telemetry stream to the powered PCMMU. The PDI also interfaces the SM GPC through the PL 1 bus. The PL 1 bus interface is used for DFL/FPM loads and SPEC 62 status updates. The PDI interface to the GCIL allows the PDI configuration to be made by command from MCC or panel switches.

4.4 PDI TELEMETRY PATH

4.4.1 Inputs

The PDI has seven telemetry inputs (Figure 4-1) Inputs 1 through 5 are reserved for hardline payloads. Inputs 1 and 2 are for OIU 1 and 2 respectively; input 3 for FS or SHAB (if flown); input 4 for Still Sequential Video (SSV); input 5 for TCS and input 6 is reserved for RF telemetry coming from the PSP-PI path. Up to four of these inputs may be active at any one time. Input 7 is a test input for ground operations and is not used on-orbit.

4.4.2 Switch Matrix

In flight, the switch matrix is used to connect the inputs to the decommutators. The connections are loaded into the switch matrix through PL 1 bus from SM SPEC 62 inputs (Figure 4-2) or uplink command load. Each decommutator may be assigned to only one input at a time, however any input may be assigned to more than one decommutator at a time. The SM GPC uses PL 1 bus to update the input assignments on SPEC 62 on a once-per-second refresh.

4.4.3 Decommutators

Telemetry enters the four decommutators from the switch matrix. The decommutators select and route telemetry data to be stored in the PDI RAM and/or toggle buffer. The program instructions used by the decommutators are called Decommutator Format Loads (DFLs). The DFLs are loaded into the decommutators by the crew from SM SPEC 62 inputs or by MCC UL CMD. The DFLs are loaded into the decommutators by the crew from SM SPEC 62 inputs or by MCC UL CMD. The DFL is loaded from the Mass Memory Unit (MMU) using the SM common buffer, into a decommutator through the PL 1 bus (Figure 4-1). The DFL load procedures, LOAD PDI DECOM FORMAT, are located in the Flight Supplement section of the Orbit Operations Checklist. There may also be references to DFL loads in payload operations FDF.

4.5 PDI RANDOM ACCESS MEMORY

The decommutators will send the PL telemetry to a RAM for temporary storage. When the PCMMU needs PL telemetry, it will send a demand signal to sequentially access the RAM addresses. Once the data is inside the PCMMU, then the SM GPC can access the PCMMU memory to gather the payload telemetry for display on flight-specific SM displays.

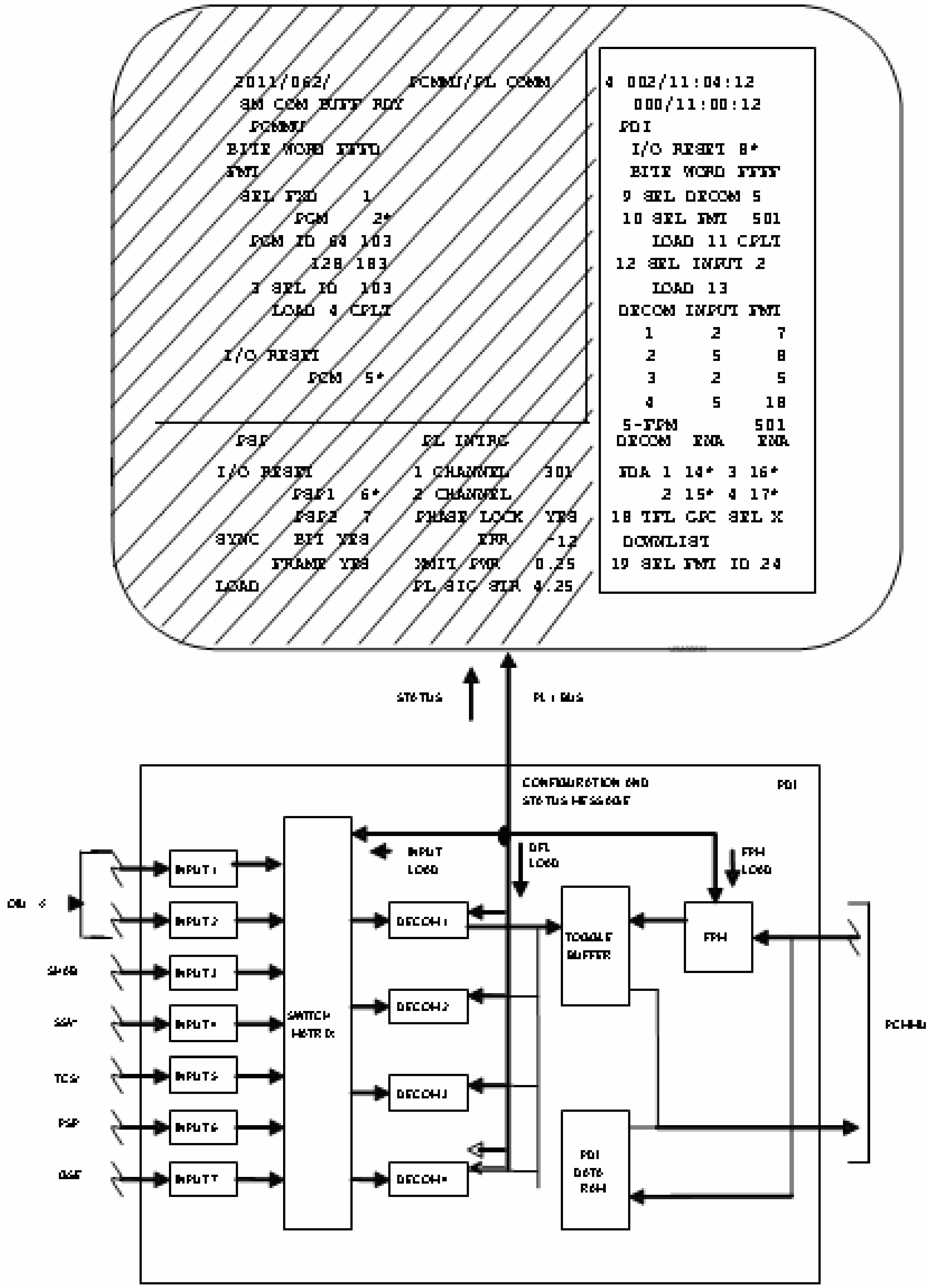


Figure 4-1. Payload data interleaver

4.6 TOGGLE BUFFER AND FETCH POINTER MEMORY

The decommutators also send the PL telemetry data to the toggle buffer (Figure 4-1). The toggle buffer is a memory device which can read-in and write-out data, simultaneously. Four independently operating sections allow for a constant data flow out of the PDI. The toggle buffer requires a set of instructions loaded in the FPM, to access the data address locations. When requested, the toggle buffer data are sent to the PCMMU, where the data are combined with OI telemetry and GPC downlist into the orbiter downlink telemetry stream.

The FPM is loaded from the MMU into the PDI through the PL 1 bus. The FPM affects only toggle buffer telemetry. The load procedure, LOAD PDI DECOM FORMAT, is located in the Flight Supplement section of the Orbit Operations Checklist, in the COMM/INST section.

Note: The only time the SM GPC checks to see if the formats are in the decoms is during a DFL load. Thus, after a transient PDI power loss, the formats would be lost from the decoms and the FPM, but would still appear to be loaded on SM SPEC 62. The formats on the screen would just be static data. Hence, after a PDI power loss, the decoms and FPM need to be reloaded.

4.7 PDI STATUS

The PDI field on SM SPEC 62 displays the inputs loaded into the switch matrix (Figure 4-1). These inputs are updated on SM SPEC 62 on a once-per-second interval through the PL 1 bus and are displayed beside the chosen decom (1 through 4). The formats are displayed beside the inputs, but are not updated.

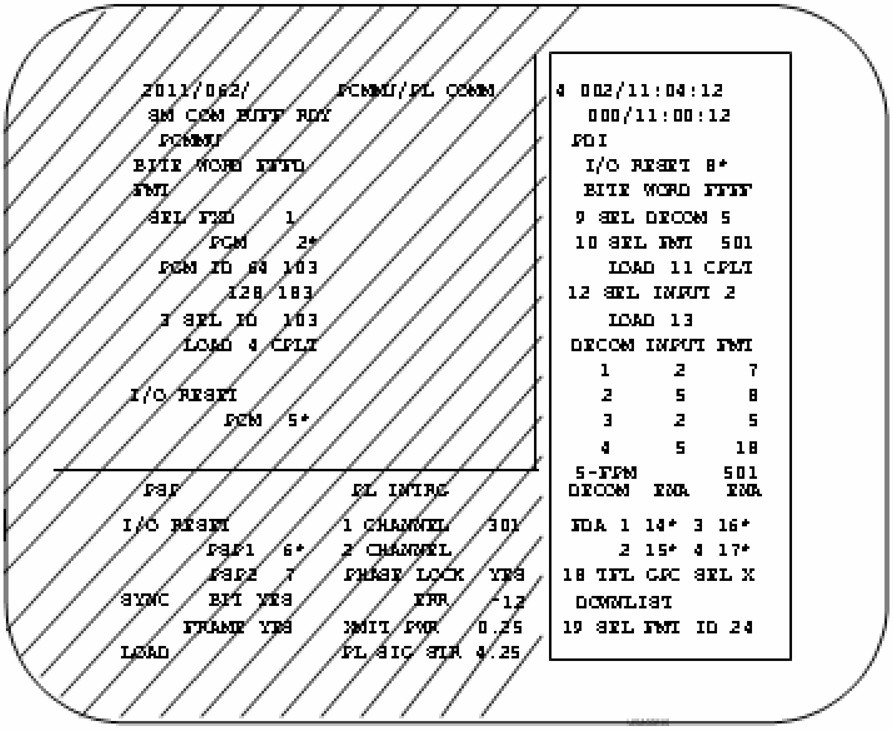


Figure 4-2. SPEC 62 - PDI field

Questions

1. If there is a power loss to the PDI, the __________ display on SPEC 62 cannot be trusted.

   a. Format

   b. Input

   c. FDA

2. Input ________ of the PDI is reserved for the PSP (RF) input.

3. DFL, FPM, and switch matrix inputs are loaded from the SM GPC to the PDI through the __________ bus interface.

4. PDI inputs 1 through 5 are reserved for _________ inputs.

   a. PDI

   b. HL

   c. PL UMB

5. The PDI _________ stores data going to the SM GPC displays.

   a. Toggle buffer

   b. Switch matrix

   c. Decommutator

   d. RAM

6. The PDI __________ stored data going to the ground.

   a. RAM

   b. Switch matrix

   c. Toggle buffer

   d. Decommutator

5.0 DECOMMUTATOR FORMAT LOAD PROCEDURES

5.1 OBJECTIVES

After completing this section, the student will be able to

a. Locate the LOAD PCMMU FORMAT and LOAD PDI DECOM FORMAT procedures in the FDF

b. Explain how to load the PDI DFLs, FPM, and inputs on SM SPEC 62

c. Explain the reasoning behind each step in both procedures

5.2 INTRODUCTION

The DFLs are entered on SPEC 62 using the LOAD PDI DECOM FORMAT procedure located in the Flight Supplement portion of the Orbit Operations Checklist. Flight Supplement procedures contain different configurations (specified by the configuration number) for different phases of flight. In preparation for the procedure discussion, it is recommended that you find a copy of the Orbit Ops C/L and look up the procedure.

The TFL procedure, LOAD PCMMU FORMAT, is also found in the Flight Supplement portion of the Orbit Operations Checklist. During the payload operation phase of flight, the TFLs and DFLs must be correlated for the PCMMU to know what data are coming from the PDI. The configuration number for the TFL should match the configuration number for the DFL to be compatible (see Orbit Operations Checklist, Flight Supplement for an example).

5.3 PROCEDURES DISCUSSION

The DFLs are entered from SPEC 62. The PDI must have an I/O interface with the SM GPC before a DFL DECOM input formats or FPM load is done. The I/O interface is established over the PL 1 bus with an ITEM 8 EXEC on SPEC 62 (Figure 5-1). An asterisk will appear beside the I/O RESET after the ITEM 8 EXEC.

Crewmembers may load the PDI DFLs, FPM, and inputs under the PDI field on SM SPEC 62. The ITEM 9 + X EXEC is used to select the decommutator (1 through 4) or the FPM (5) to be loaded. The ITEM 10 + XXX EXEC is used to choose the DFL format XXX or the FPM format XXX. The ITEM 11 EXEC will load the DFL or FPM format into the previously selected decommutator or FPM, respectively. The ITEM 12 + X EXEC will tie the input to the previously selected decommutator. The ITEM 13 EXEC will load the input into the switch matrix (not required for the FPM load).

The configuration table is used along with the LOAD PDI DECOM FORMAT procedure. The procedure gives the SPEC 62 item executions and the table gives the data to be substituted into the procedure. Below is an example of how the procedure would use the table entries on SM SPEC 62. Reference Table 5-1 and Figure 5-1.

Example using Table 5-1, SHAB and OIU example for configuration (CONFIG) 763:

a. The ITEM 9 + 1 EXEC on SPEC 62 will select decom 1.

b. The ITEM 10 + 30 EXEC on SPEC 62 will select format FMT 30.

c. The ITEM 11 EXEC on SPEC 62 will load FMT 30 into decom 1.

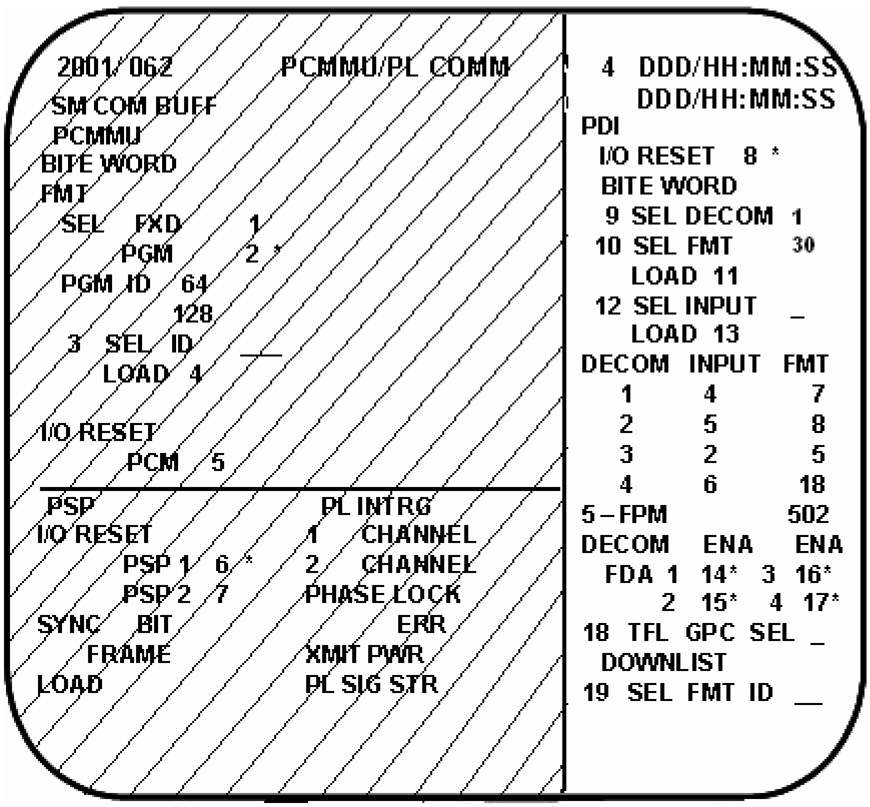


Figure 5-1. SPEC 62 - PDI load

d. During the ITEM 11 EXEC, RUN will appear beside LOAD 11. The RUN indicates the SM GPC is collecting the DFL from the MMU. Also, a BSY will appear beside the SM COMM BUFF. The BSY indicates the DFL is being stored temporarily in an SM GPC buffer. Afterwards, LOAD will return to CPLT and SM COMM BUFF will return to RDY.

e. Item 12 selects desired input.

f. ITEM 13 EXEC will load input (source) for Payload associated with Decom X.

To finish loading the configuration table, repeat the same ITEM entries, using the table line-by-line to the end. Notice the FPM is treated just like another decom. On SPEC 62 it is labeled 5-FPM. The last line of PRIME CONFIG will select the FPM with an ITEM 9 + 5 EXEC (just like the decom). The last entry for the PRIME CONFIG is

formatted 503. The format will be selected with the ITEM 10 + 503 EXEC (Table 5-1). The ITEM 11 EXEC will load this format into the FPM. The RUN and BSY indications will appear as before. The CPLT and RDY indications will also appear as before. No input selection is required for the FPM.

5.4 SPEC 62 FEEDBACK

After each ITEM execution, the entry will appear beside the ITEM number on SPEC 62. The ITEM entries will also appear below the LOAD 13 after a LOAD is performed (ITEM 11 or 13) on SPEC 62 (Figure 5-1).

Table 5-1. PDI Configuration Table

CONFIG	DECOM	FMT	INPUT	USE
763 RNDZ w/UHF FMT CCSU (PRIME) TFL 192	1 2 3 4 5-FPM	30 - 9 4 503	1,2 - 5 4	OIU7 (CCSU)* - TCS SSV(3)*** H-H-H*
770 RNDZ w/UHF FMT CCSU (BACKUP) TFL 211	1 2 3 4 5-FPM	14 31 - 19 502	4 1,2 - 5	SSV(3)*** OIU7(CCSU)** - TCS H-H-H*

*OI-GNC-SM, Orbiter Downlist Data Rates (High or Low)

** # in OIU (#) represents the OIU format and data type

*** # in SSV (#) represents the SSV Out Rate sw selection

Questions

1. ITEM __________ + XX EXEC will select the DFL/FPM format XX.

    a. 9

    b. 11

    c. 12

    d. 10

2. ITEM 11 EXEC will load the selected format into the chosen decommutator. (yes/no)

3. During an ITEM 11 EXEC, RUN will appear beside the LOAD, and BSY will appear beside the SM COMM BUFF. (yes/no)

4. The TFLs and DFLs may be correlated by the __________ number.

5. The FPM load is treated the same as a decom load. (yes/no)

6. The LOAD PDI DECOM FORMAT procedure is in the ________ _________ section of the Orbit Ops C/L.

7. ITEM 12 + X EXEC and ITEM 13 EXEC loads

    a. DFLs into decommutators

    b. Inputs into the switch matrix

    c. FPM into the PDI

6.0 DECOMMUTATOR ERROR INDICATION (FAULT DETECTION ANNUNCIATION)

6.1 OBJECTIVES

After completing this section, the student will be able to

a. Understand how to enable FDA for any decommutator

b. Explain what situation will cause the FDA to take effect

c. Explain what will happen if the FDA is tripped

6.2 INTRODUCTION

The FDA is an SM software package that checks whether a chosen decom is locked onto its telemetry stream. If the FDA detects that the enabled decom has lost lock, then S62 PDI DECOM FAIL appears on the GPC fault message line (Figure 6-1). Also, an up-pointing arrow appears by the affected decom on SPEC 62. The message could mean one of three things; the decom has failed, there is a format problem, or the decom has not received the telemetry stream in the first place.

6.3 FDA FUNCTION

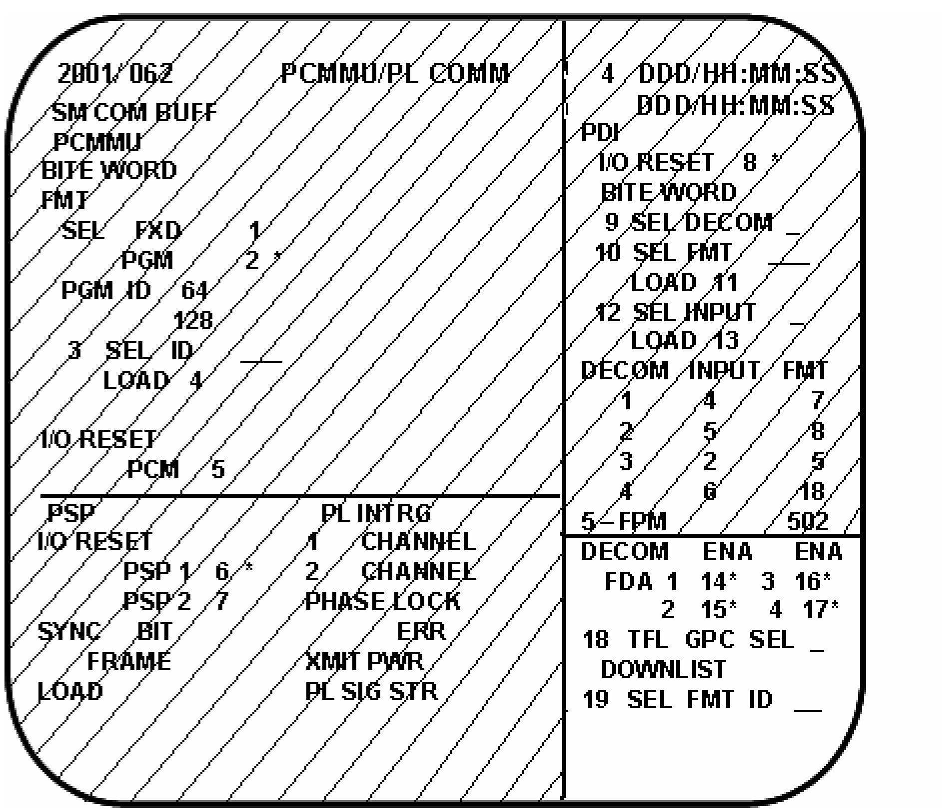


Figure 6-1. SPEC 62 - FDA field

The FDA for chosen decom is enabled or disabled by an item execute on SPEC 62 (Figure 6-1). The item numbers are 14, 15, 16, and 17 (located in the lower right-hand corner of SM SPEC 62). An item executed next to the appropriate decom toggles the asterisk between two states, present and not present. When the asterisk is present, the FDA is enabled for that decom. When the space is blank, the FDA is not enabled. If the FDA is not enabled and there is a loss of telemetry lock in the decom, the message and arrow will not appear. Of course, MCC would know that the decom has lost lock even though there has been no warning to the crew due to loss of PL data.

Questions

1. SM SPEC ________ is used to enable the FDA system.

2. Item number ________ will toggle the FDA asterisk for decom 2.

3. If the FDA is not enabled and decom loses lock, the message and the arrow will still appear. (yes/no)

4. Triggering the FDA does not necessarily mean the decom has failed. (yes/no)

7.0 PAYLOAD COMM TROUBLESHOOTING

7.1 OBJECTIVES

After completing this section, the student will be able to

a. Identify where to find the malfunction points diagram in the FDF

b. Explain how to locate the malfunction point on the diagram according to the GPC message received and the SPEC 62 signature

c. Identify how to distinguish between an interface and an LRU malfunction

7.2 INTRODUCTION

PL COMM malfunctions can be difficult to diagnose. The fault annunciation message "S62 PDI Decom" can cover a multitude of different PL COMM problems. Successful troubleshooting of the system involves using: (1) data found on SPEC 62, (2) the Malfunction Procedures, and (3) the PL COMM Malfunction Points diagram. The PL Comm Malfunction Points Diagram is found in the Malfunction Procedures, section 2 (COMM), and provides information of PL COMM interfaces and LRUs (Figure 7-2).

7.3 DOWNSTREAM METHOD

It is best to approach the diagram using the "downstream" method. This means review the diagram starting with the LRU farthest down the payload telemetry stream (the PCMMU) and trace the way up to the payload. As you go along the path, stop at each LRU or interface and examine SPEC 62 for messages corresponding to the diagram messages and look under the four data fields on SPEC 62: PSP, PI, PDI, and PCMMU (Figure 7-1). The data under each field should give an indication of the LRU status. As you move up the telemetry stream, the malfunction is usually at the last LRU or interface that shows a problem. There are indications downstream because the problem will propagate down the telemetry path. Also, notice that there are three interfaces that may intersect this telemetry downstream path. These interfaces are the PF MDM to PSP interface, the PL 1 bus to PDI interface, and the SM to PCMMU interface. If one of these interfaces gives a message, it may either be a problem with just that interface or it may be the confirmation of an LRU problem found by using the downstream method. On the following pages, several PL COMM LRU and interface problems are described, along with the downstream troubleshooting technique and the corrective action.

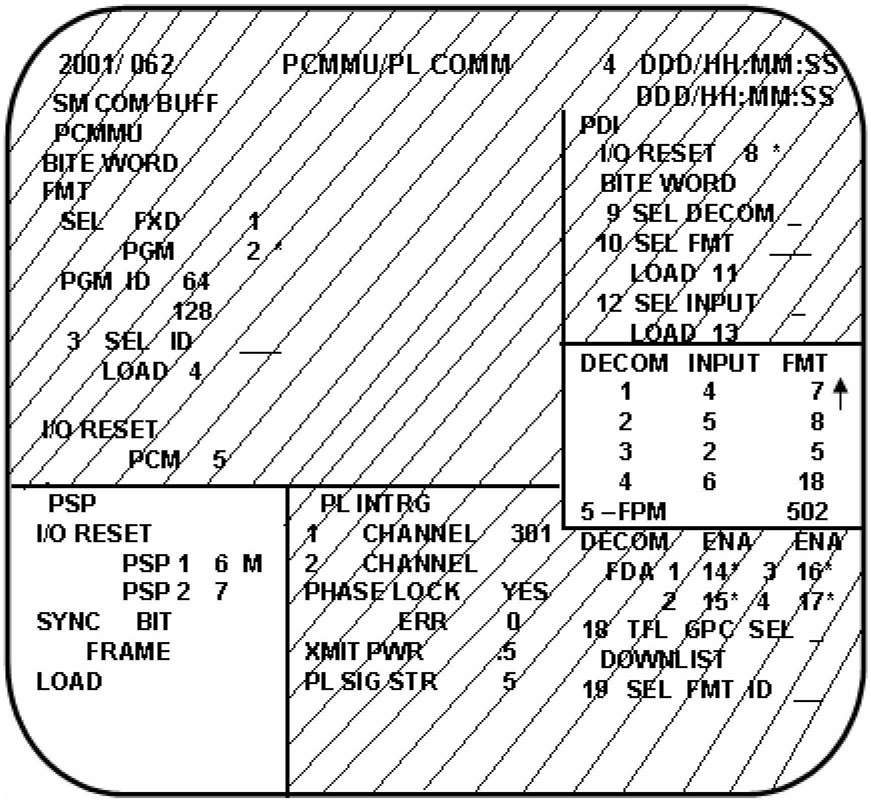


Figure 7-1. SPEC 62 - PSP power signature

7.4 LRU POWER SIGNATURES AND THE MAL POINTS DIAGRAM

7.4.1 PSP Power Signature

If the PSP power is failed, two SM GPC messages are produced on the SM FAULT SUMM SPEC: S62 BCE BYP PSP (1) and S62 PDI DECOM FAIL (if FDA is enabled). For an RF payload, the S62 PDI DECOM FAIL message appears only if the PDI was processing associated payload telemetry stream. An up arrow also appears by the affected decommutator on SPEC 62 (Figure 7-1). The PSP I/O interface with the SM GPC is broken and shows an “M.”

Using the PL COMM Malfunction Points diagram (Figure 7-2) and the downstream method, the first LRU to check is the PCMMU. Checking on SPEC 62 (**Error! Reference source not found.**), there is no problem in the PCMMU fields. Moving up through the PDI, the up arrow on SPEC 62 shows there is a problem with decommutator 1 losing telemetry lock and thus giving the S62 PDI DECOM FAIL message. SPEC 62 shows that decommutator 1 has input 4 connected to it. 4 is a hardline input (no PI). Going up to the PSP, the SPEC 62 field shows a complete loss of I/O with SM GPC and blank data fields. The combined indications indicate a PSP failure. The combined indications indicate the PSP failure. The S62 BCE BYP PSP 1(2) intersects the PSP on the PL COMM Malfunction Points diagram (Figure 7-2), thus confirming the PSP power failure.

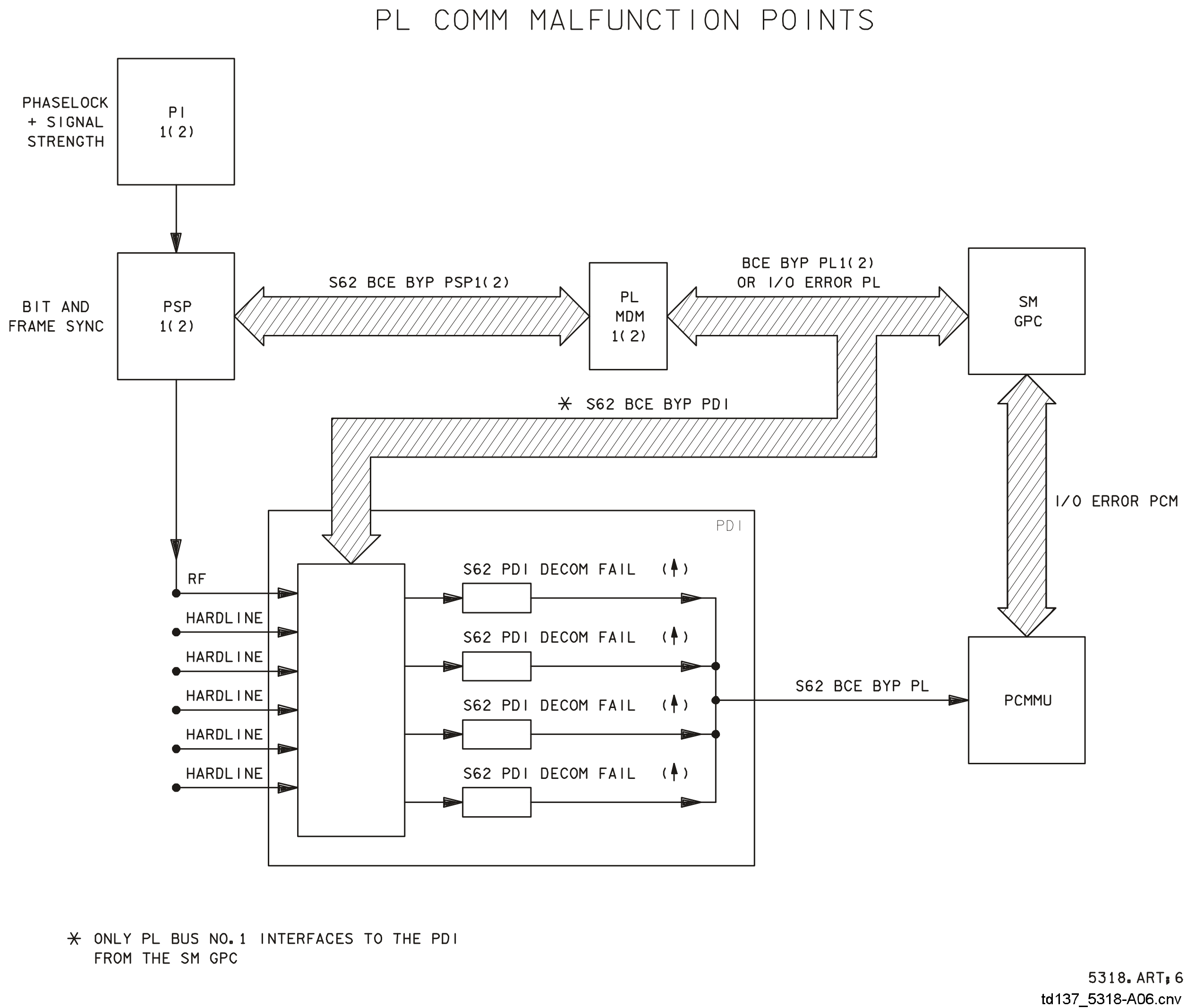


Figure 7-2. Malfunction Points Diagram

7.4.1.1 Corrective Action

In this case, switching the SYSTEM switch (1 or 2) on panel A1L to the alternate PSP solves the problem.

Note: For any system (1 or 2) switch, the PSP-GPC I/O interface must be reset for the new PSP. The I/O reset is performed with an ITEM 6 or ITEM 7 on SPEC 62. Also, the configuration message must be reloaded for the new PSP. The SYSTEM change will switch both the PSP and the PI to the alternate pair.

7.4.2 PI Power Signature

If the PI power is failed while processing an RF payload data only and the FDA is enabled, there is an S62 PDI DECOM FAIL on the SM FAULT SUMM and an arrow beside the affected decom. The PI field on SPEC 62 shows a complete loss of data (Figure 7-3). Also, PSP BIT and FRAME SYSNC both will read NO under the PSP field on SPEC 62.

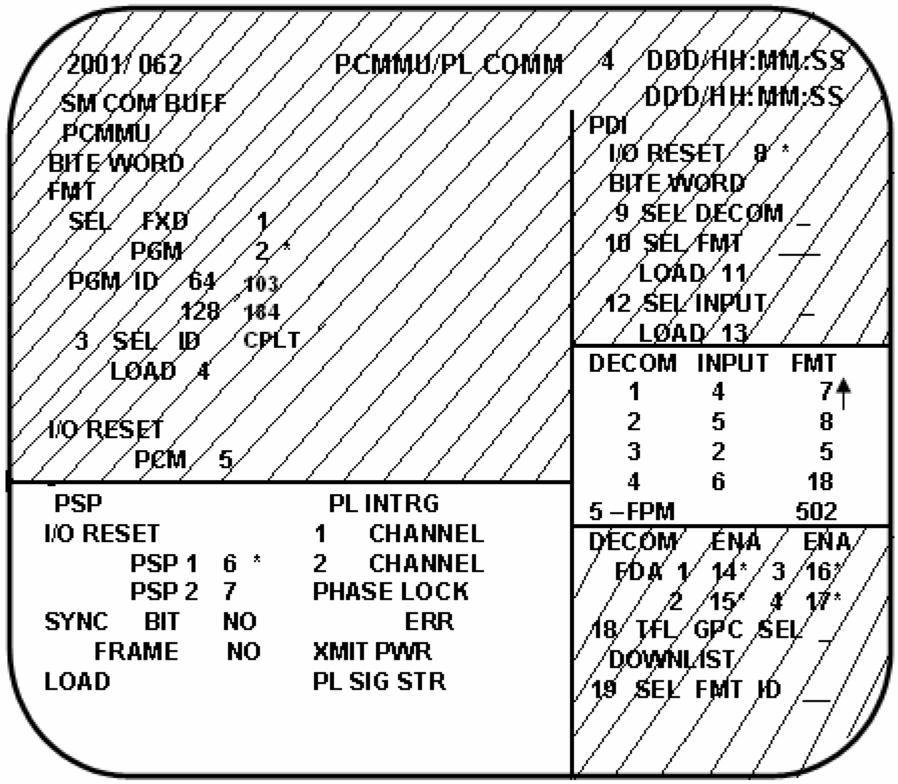


Figure 7-3. SPEC 62 - PI power signature

For the downstream method, we start again at the PCMMU and trace the problem through each LRU all the way up to the PI (Figure 7-2). The S62 PDI DECOM FAIL message and the up arrow on SPEC 62 show there is a problem with a decom (Figure 7-3). Moving up the RF path, there is a loss of PSP BIT and FRAME SYNC on SPEC 62. Complete loss of data verifies the PI power failure in this case (remember PI status data goes to SPEC 62 through the OI MDM OF2).

7.4.2.1 Corrective Action

In this case, switching the SYSTEM (1 or 2) to the alternate solves the problem.

7.4.3 PDI Power Signature

If the PDI power is failed, three messages appear on the SM FAULT SUMM: S62 BCE BYP PDI (ITEM 8) between SM and PDI, S62 PDI DECOM FAIL (ITEM 5) between PCMMU and PDI, and S62 BCE BYP PL. Also, there are M's by the PDI decom/input/format display field and by the PDI I/O RESET (Figure 7-4).

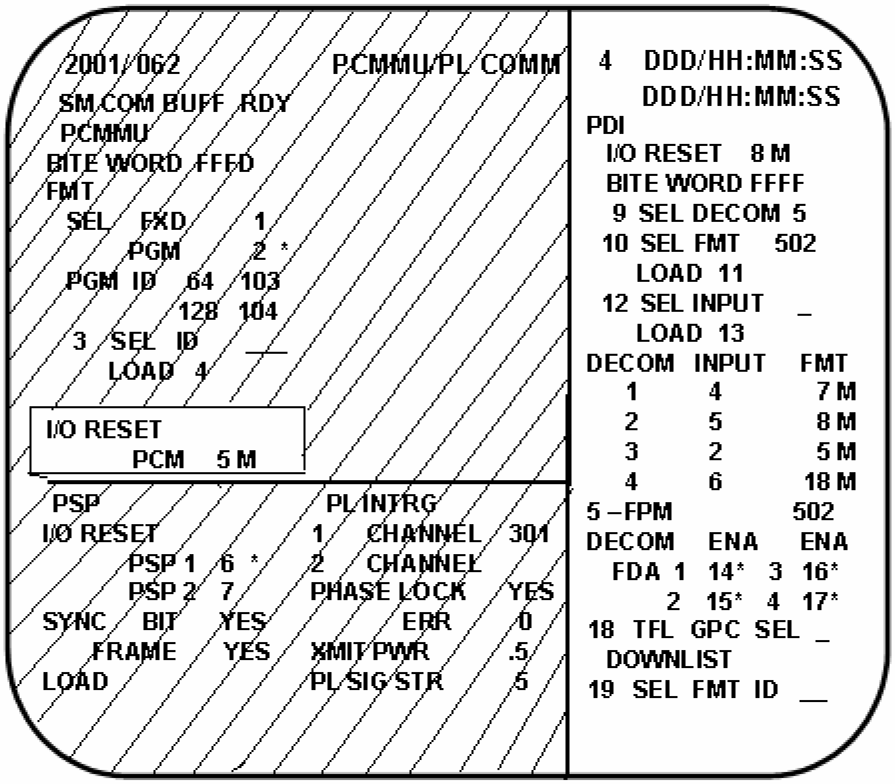


Figure 7-4. SPEC 62 - PDI power signature

Using the S62 BCE BYP PL and S62 PDI DECOM FAIL messages, the problem is traced up to and inside the PDI (Figure 7-2). The Ms by PDI I/O RESET and by the display field on SPEC 62 (Figure 7-4) confirm that the PDI status is not reaching the SM GPC through the PL1 Bus. The S62 BCE BYP PDI message isolates the PDI as the point-of-failure.

7.4.3.1 Corrective Action

An In-Flight Maintenance (IFM) procedure may be performed to replace the PDI if a spare PDI is manifested.

7.5 INTERFACE SIGNATURES AND THE MAL POINTS DIAGRAM

7.5.1 PSP-PDI Signature

The signature for a PSP/PDI interface failure appears under the SM FAULT SUMM: the S62 PDI DECOM FAIL message and an up arrow by the affected decom (Figure 7-5). There is one main difference between a PSP/PDI interface failure and a PSP power failure for an RF payload: the PSP/PDI interface failure shows the PSP is still processing telemetry (PSP BIT and FRAME SYNC both read YES).

Starting from the PCMMU and tracing the downstream path, the message and the arrow lead us to a decommutator in the PDI (Figure 7-2). In this case, the problem

propagates downstream from the PSP/PDI interface to the decom. The signature is no different from a decom failure signature.

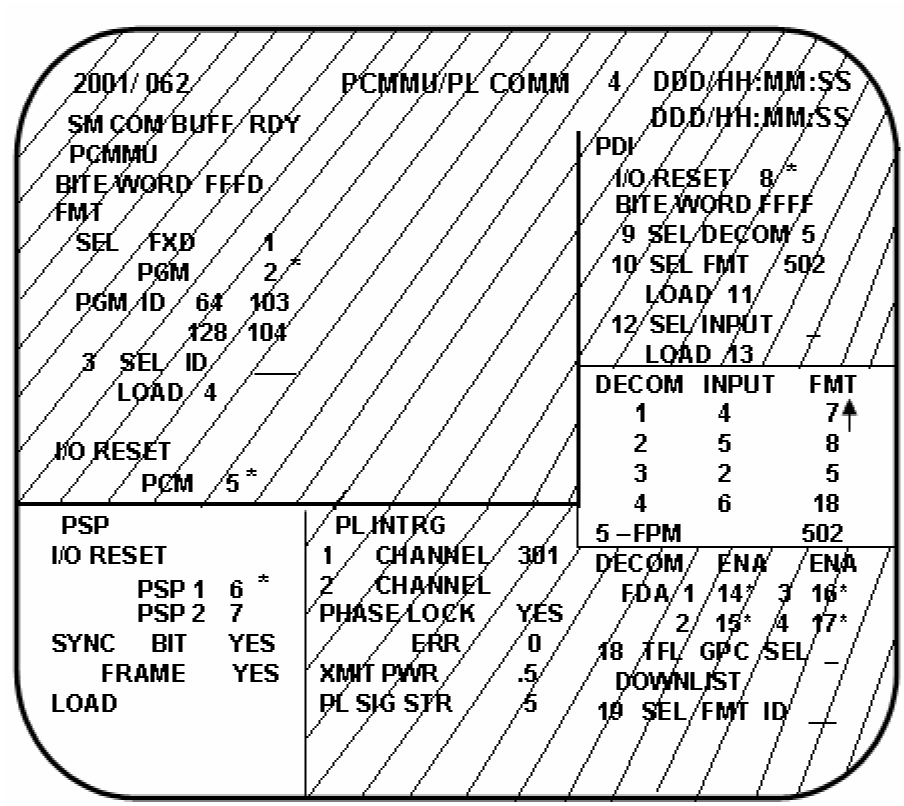


Figure 7-5. SPEC 62 - PSP-PDI signature

7.5.1.1 Corrective Action

If the PI/ PSP pair (1 or 2) is switched to the alternate system, a new PSP/PDI interface is used (although, the same PDI is still used). The new interface solves the problem and removes the failure signature.

7.5.2 PSP/PF MDM Signature

The signature for a PSP/PF MDM interface failure is an S62 BCE BYP PSP 1(2) message and an M by the I/O RESET PSP (1 or 2) on SPEC 62 (Figure 7-6). This failure inhibits the PSP BIT and FRAME SYNC status of an RF payload and the PSP/SM interface status from being sent through the PF MDM to SPEC 62. FDA does not annunciate an S62 PDI DECOM FAIL message in this case because the PDI is still processing RF payload data from the PSP.

Using the downstream method, the problem appears to have something to do with the PSP (Figure 7-2). This is not true; otherwise, the problem would propagate to the PDI. The S62 BCE BYP PSP 1(2) message points to the PSP/PF MDM interface. Also, the

loss of PSP status points to the same problem because the status travels through the PSP/PF MDM interface.

7.5.2.1 Corrective Action

A PSP power cycle may clear a logic lockup on the PSP/PF MDM interface. If the power cycle does not work, moving the SYSTEM (1 or 2) switch to the alternate position will solve the problem.

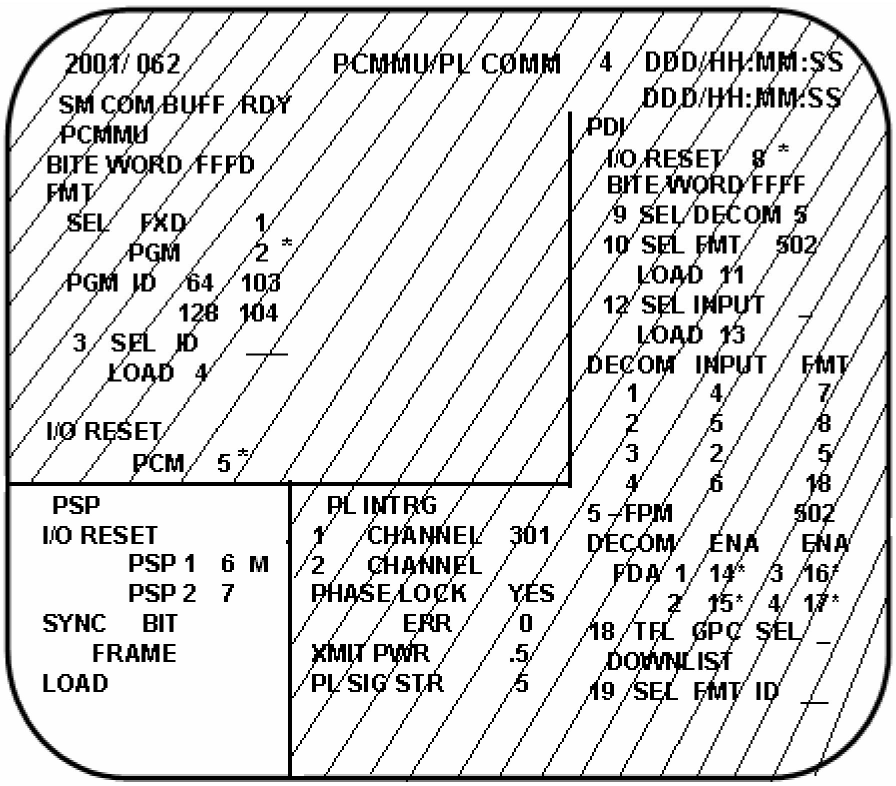


Figure 7-6. SPEC 62 - PSP-PF signature

7.5.3 PDI/PCMMU Signature

The signature for a PDI-PCMMU interface failure is an S62 BCE BYP PL message and an “M” by the PCMMU I/O RESET 5 on SPEC 62 (Figure 7-7).

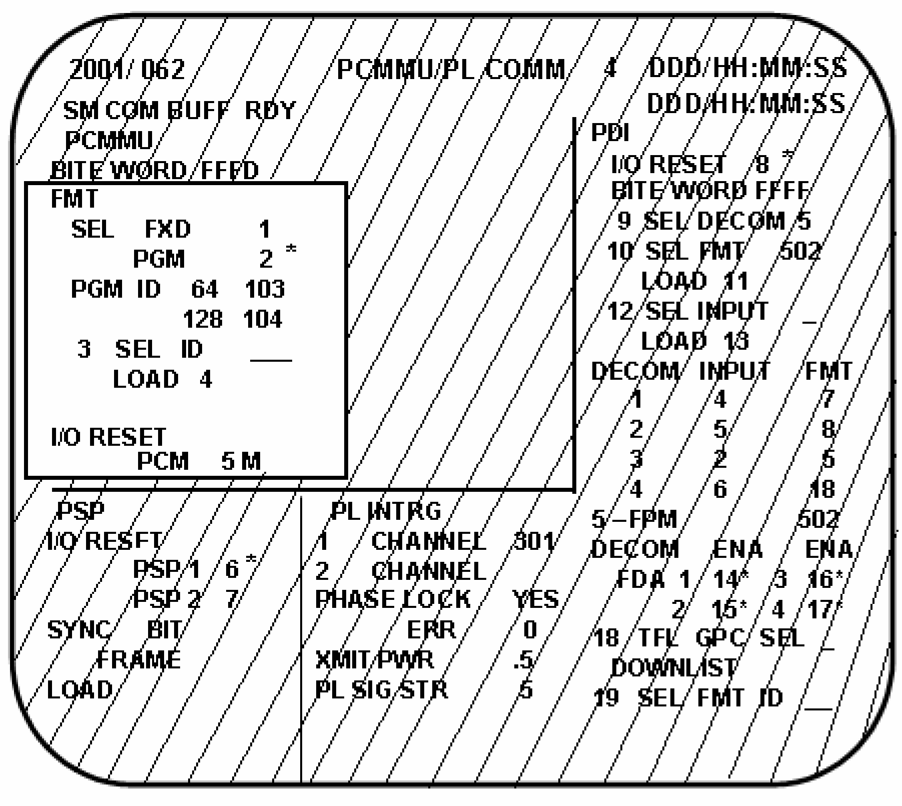


Figure 7-7. SPEC 62 - PDI-PCMMU signature

The S62 BCE BYP PL message points straight to the PDI-PCMMU interface problem (Figure 7-2). The Ms on the SPEC 62 field confirm there is a problem with an interface to the PCMMU (Figure 7-6).

7.5.3.1 Corrective Action

The problem may be resolved by switching the PCMMU (1 or 2) to the alternate unit. This swap results in a different PDI-PCMMU interface although the same PDI is still used.

Note: Switching PCMMUs requires that the PCMMU I/O RESET be reestablished, and the TFLs must be reloaded into the alternate PCMMU. These are located in the Flight Supplement portion of the Orbit Ops C/L.

Questions

1. The three messages, S62 BCE BYP PDI, S62 PDI DECOM FAIL, and S62 BCE BYP PL, isolate the problem to the ________.

    a. PSP

    b. PI

    c. PCMMU

    d. PDI

2. The PI field on SPEC 62 shows a complete blank if the PI power is turned off. (yes/no)

3. True or False. After PI power is turned off, the PSP BIT/FRAME SYNC field goes blank also.

4. A PSP power failure would produce the two messages, S62 BCE BYP PSP 1(2) and ________, and an up arrow beside the decommutator with input 6 assigned to it.

    a. S62 PDI DECOM FAIL

    b. S62 BCE BYP PL

    c. S62 BCE BYP PDI

    d. BCE BYP PL1(2)

5. A PSP power failure would also produce a loss of PSP ________ and _________ sync data for RF PLs and “M” by the PSP I/O reset.

6. Using the downstream method, you should start at the PCMMU and trace the payload telemetry path. (yes/no)

7. A PSP-PF MDM interface failure causes an S62 PDI DECOM FAIL message and an up arrow by the decommutator which lost lock. (yes/no)

8. For a PSP-PDI failure, the PSP BIT and FRAME SYNC on SPEC 62 reads __________.

8.0 ORBITER INTERFACE UNIT (OIU)

8.1 OBJECTIVES

After completing this section, the student will be able to

1. State the two mutually exclusive functions of the OIU.
2. Identify the key Shuttle Interfaces for the OIU.
3. Identify several devices that the OIU is the interfacing LRU for MS1553B/Station Operations.
4. Identify from FDF and associated crew displays and controls how to determine the required OIU and PDI/PCMMU formats for proper data processing to MCC.

8.2 INTRODUCTION

The Orbiter Interface Unit (OIU) is an asynchronous LRU that serves two separate functions. The OIU checks and expedites commands to the International Space Station (ISS) or devices utilizing ISS-compatible protocol. It also processes telemetry (data) from these devices to route to the PDI in PDI-compatible serial data streams. Both the commands and telemetry path between the OIU and ISS device use the Military Standard 1553 B (MS 1553B) protocol. Specifically the OIU is the translator, or interface LRU, between the Orbiter Payload Signal Processor (PSP), the Payload Data Interleaver (PDI), and the ISS Command and Data Handling System (C&DH) MS 1553B communication buses. The OIU also provides a MS 1553B interface to the Space-to-Space Orbiter Radio (SSOR), adding an RF command and telemetry path to the ISS while in the proximity operations phase of flight (end of rendezvous timeline). The OIU is manifested like a Shuttle payload whenever an ISS Mission, or payload requiring the MS 1553B protocol, is flown.

8.3 INTERFACES

The two OIU LRUs are located behind panel L11 (**Error! Reference source not found.**) and have Ground Support Equipment (GSE) access on the PDIP panel for Ground Processing; i.e., loading mission specific reconfiguration data tables pre-launch, and crew access on the Standard Switch Panel (SSP) for OIU activation. The Power Switch is a three-position switch for selecting OIU/OFF/OIU2, and the talkback shows UP when OIU 1 is ON, DN when OIU 2 is ON, or barberpole when OIU is OFF (Figure 8-2).

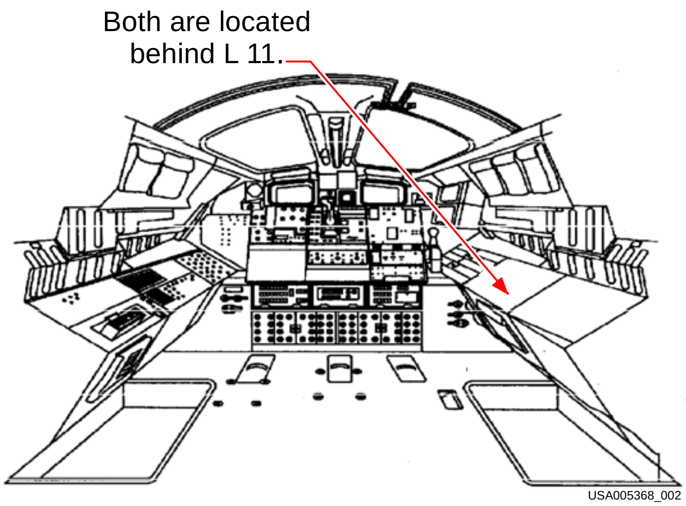


Figure 8-1. OIU Location

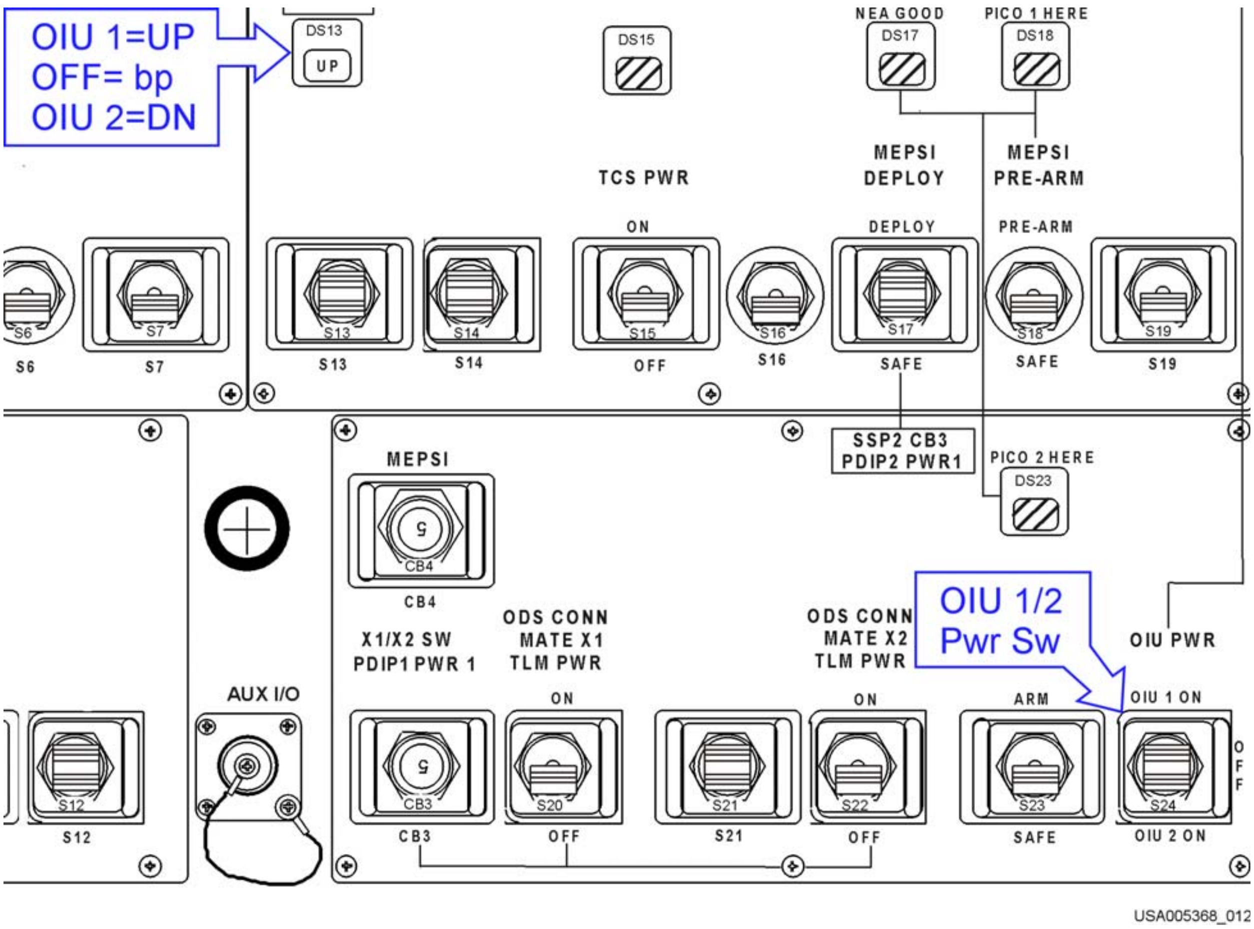


Figure 8-2. Standard Switch Panel

The OIU receives and routes commands from the PSP to the active device on the MS1553B bus, such as the SSOR, MPLM, or ISS MDM C&DH. It receives data from this same device, multiplexes (combines) this data with OIU health and status into one telemetry stream, and supplies that telemetry stream to the PDI. The OIU also sends temperature data to SM GPC using the associated PL MDM. The Payload Timing Buffer (PTB) sends IRIG-B time to the OIU to update the OIU internal clock. (Figure 8-3)

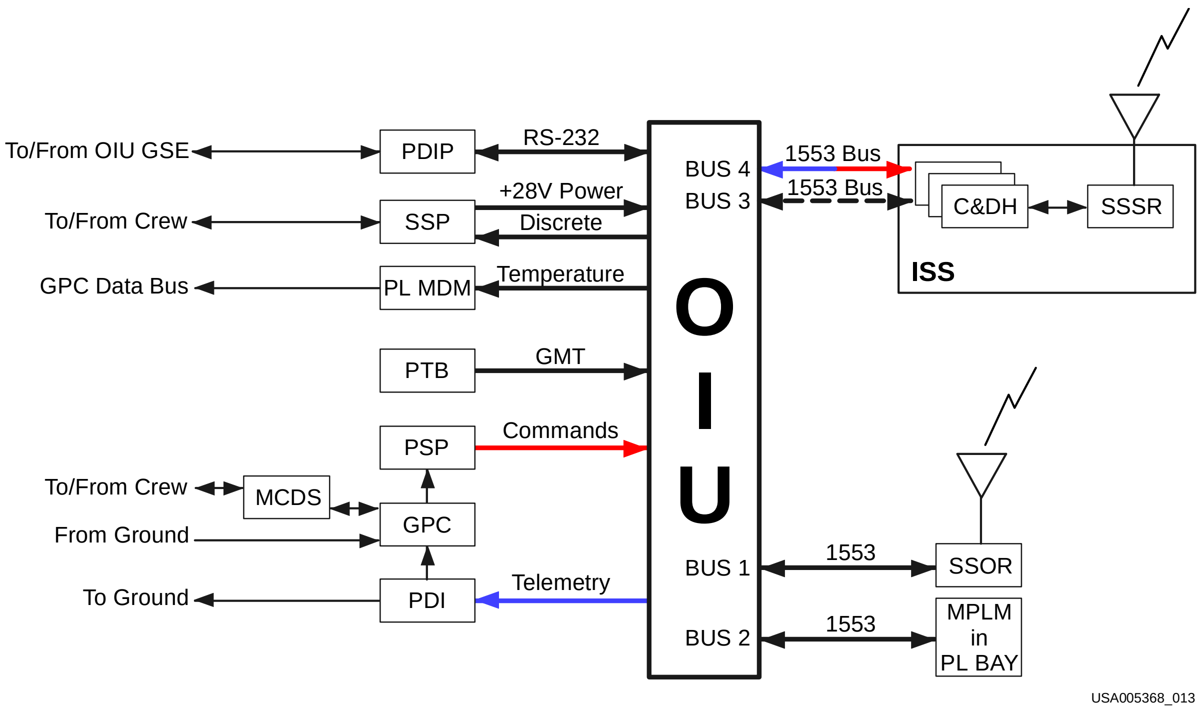


Figure 8-3. OIU Interfaces

Six interface connectors, as depicted in Figure 8-4, provide the connections for power, SSP, Orbiter LRU interfacing, MS1553B Channel A (Bus 1-4), MS1553B Channel B (Bus 1-4), and GSE. As shown in Figure 8-4, the J3 connector connects the OIU to the PSP, PDI (through the payload umbilical), and PL MDM. Therefore, if OIU 1(2) is the active OIU, then PSP 1(2), PDI Port 1(2), and PL MDM 1(2) are used for the Command/Telemetry interface from/to the Orbiter, respectively.

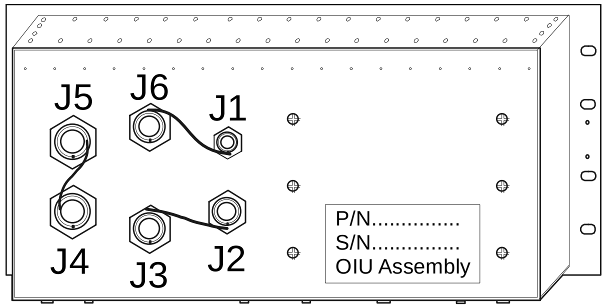


Figure 8-4. OIU Back View

Table 8-1. Connector Definitions

CONNECTOR	USE
J1	Orbiter Power (28V) Input
J2	Orbiter SSP Talkback Signal (28V)
J3	PDI, PDP, PTB, OIU Temperature
J4	1553 Channel A, Bus 1-4
J5	1553 Channel B, Bus 1-4
J6	GSE Interface

8.4 OIU COMMAND PATH

Figure 8-5 shows a simplified block diagram of the uplink command path to the OIU. The uplinked commands and voice are received through the S-Band PM or Ku-Band RF system and separated in the Network Signal Processor (NSP). Commands destined for the OIU or ISS/MS1553B bus elements are routed through the SM GPC to the associated PL MDM for the active PSP/OIU pair, 1 or 2. No cross-strap capability between PL MDM PSP OIU is available without performing the In Flight Maintenance (IFM) OIU Cable Swap procedure to switch the J3 connector at the back of the OIU boxes under the L11/L14 panels. The OIU accepts either configuration commands that control the OIU configuration or commands to be routed to devices on the MS1553B buses.

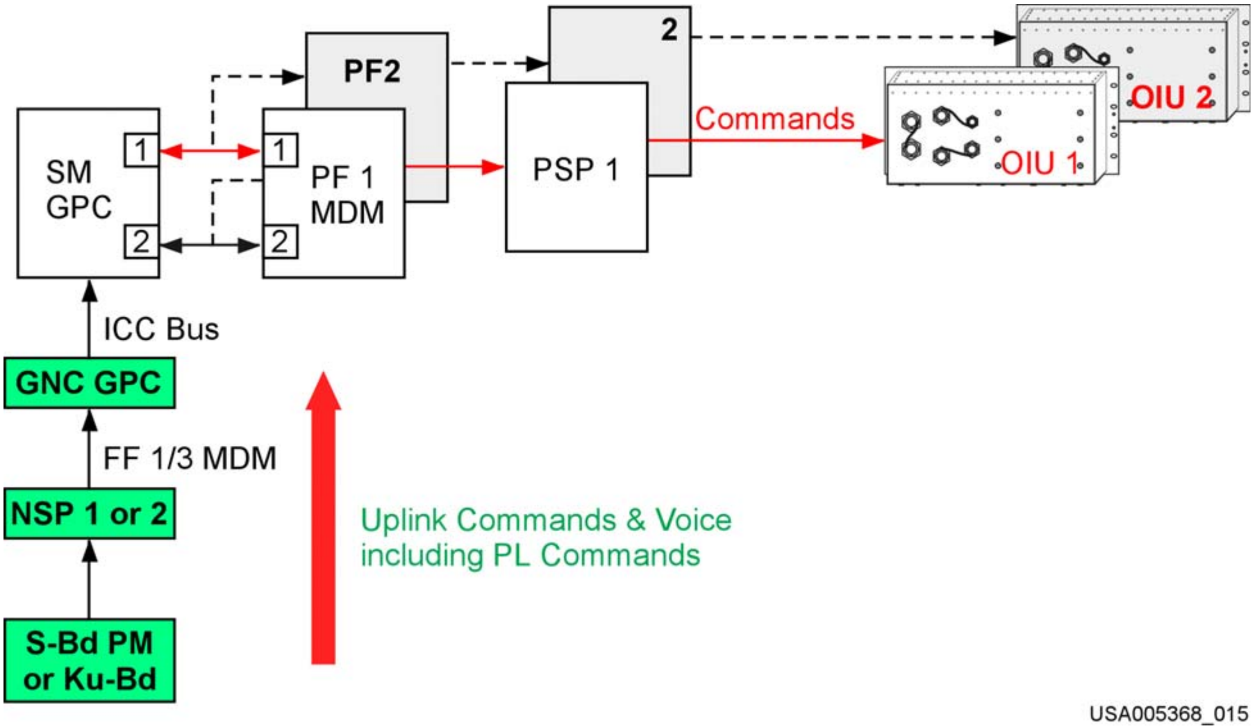


Figure 8-5. Command Path

OIU configuration commands are used for OIU PDI mode (OIU format) configuration, time updates, bus configurations, command re-routing, and changes to physical device mapping data that are defined in the reconfiguration table. Commands to MS1553B devices are routed through the OIU based upon data in the reconfiguration table. The OIU maps the logical, or active, device into a physical device and bus configuration, and routes the command accordingly. As a Bus Controller (BC,) the OIU will route commands, over channels A or B, to a physical device regardless of whether the device is active in the current format. As a Remote Terminal (RT), the OIU will make commands available for polling by the BC.

8.5 OIU TELEMETRY PATH

Figure 8-6 shows a simplified block diagram of the downlink telemetry path from the OIU through the PDI/PCMMU and Orbiter S/Ku-Band RF system(s). The OIU formats the combined internal OIU health and status information and MS 1553B device data, based on its configuration, into a serial data stream and routes it to the Pulse Code Modulation Master Unit (PCMMU) upon request. The PCMMU combines the payload data, OI data, and GPC downlist information based on is loaded high rate telemetry format load (TFL) to sends it to the NSP. The NSP multiplexes the data with downlink voice to be sent to MCC via the S/Ku-Band RF systems.

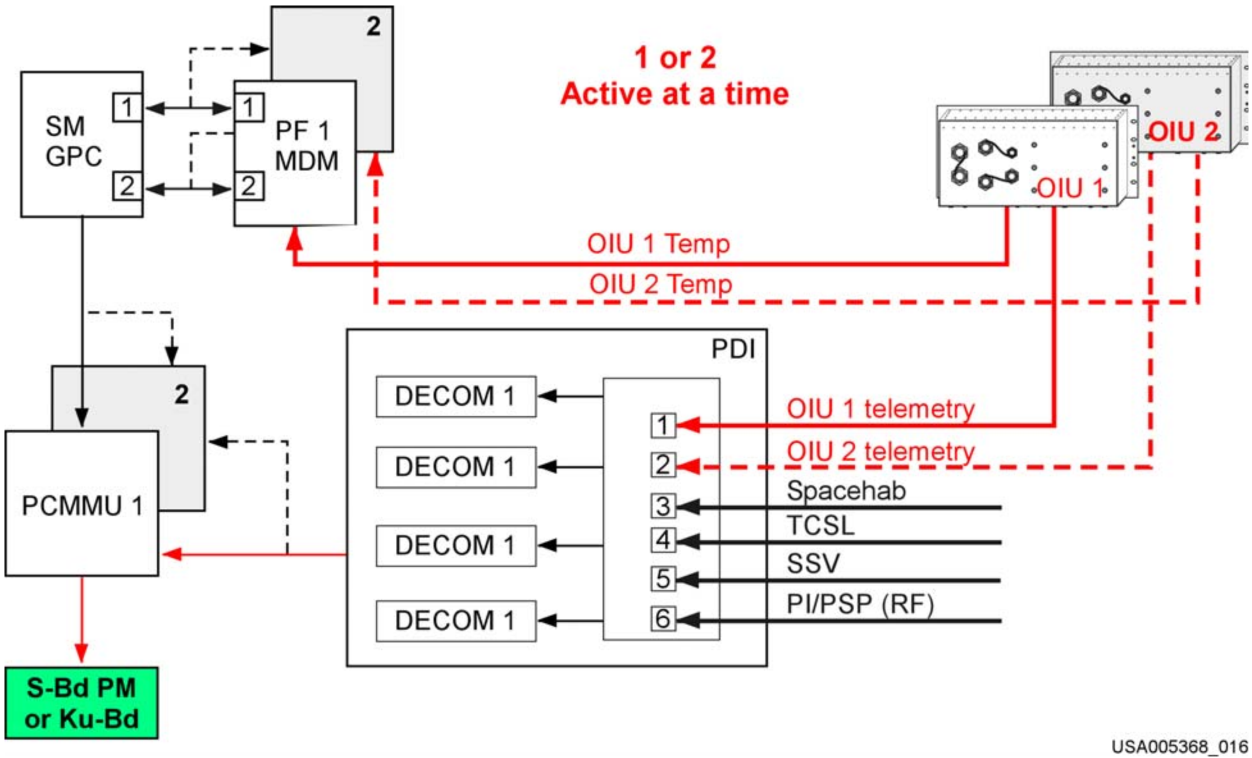


Figure 8-6. Telemetry Path

8.6 OIU FORMAT

Reconfiguration table data defines the addresses and bus numbers of the physical MS1553B devices and specifies the physical device mapping to the logical devices that communicate with the OIU. The OIU format specifies which MS1553B devices the OIU should collect data from (which logical devices are active) and how this data is to be merged with OIU health and status information and sent to the PDI. Up to twenty formats can be defined in the reconfiguration table of the OIU. However, a maximum of ten is usually defined per mission, and the OIU can only process data from one logical device at a time. Typically, MCC will handle configuration and loads to the OIU and related PSP and PDI. However, Orbiter crews can view or assist the load by configuring the PDI and OIU using SM displays SPEC 62 (PCMMU/PL COMM) and SPEC 212 (OIU) and related FDF. These crew interfaces will be reviewed in Section 8.10.

8.7 LOGICAL AND PHYSICAL DEVICES

A logical device (sometimes called active device) is a type of MS1553B On-Orbit Replaceable Unit (ORU) that communicates with the OIU, such as SSOR, MPLM, or ISS GNC MDM. The OIU reconfiguration table supplies the instructions on how to perform data transactions with each type of logical device. More than one OIU format to handle that data can be defined for a single logical device.

A physical device (PD) is the specific device that the OIU interfaces with, such as SSOR1 or GNC-1 MDM. The physical device data supplied in the reconfiguration

tables specifies the RT address and bus number for each physical MDM/ORU that the OIU may talk to during a flight, and maps these physical devices to logical devices. For example, assume the GNC MDM is an active device in the current OIU format. There are 2 GNC MDMs - a prime and a backup. Each GNC MDM is physically located on a MS1553B bus at different Remote Terminal (RT) addresses. While these two devices look the same to the OIU (same logical device), only one GNC MDM is active and talking to the OIU at a time, so the PD could be GNC 1 (Figure 8-8).

8.8 BUS CONFIGURATION

The OIU supports four hard-line MS1553B buses, each of which interface with various physical devices via ports called Bus Interface Adapters (BIAs). Typically, each BIA is dedicated to one device - SSOR normally uses bus 1, MPLM in the cargo bay (when flown) uses bus 2, and ISS GNC-MDM can use either Bus 3 or 4. Each BIA can be configured to operate as either a bus controller (BC) or remote terminal (RT); however, the OIU cannot be configured as an RT on more than one bus at any given time. As BC, the OIU will route commands over Channel A or B to a physical device, regardless of whether the device is active in the current format, and will actively request data from the physical device as specified in the current OIU format. As an RT, the OIU will make commands available for polling by the BC ISS MDM and will passively wait for data from the physical device specified in the current OIU format. When docked with the ISS the OIU is configured as an RT, with one of the GNC-MDMs configured as the BC. When used with the SSOR or MPLM the OIU is configured as the BC.

The initial bus configuration is defined as part of the reconfiguration tables. Upon power up, the OIU uses these initial settings to configure each bus, Changing OIU formats does not affect the configuration of the buses; therefore, it may be necessary to send commands to reconfigure the bus configuration data. The bus reconfiguration must be completed prior to changing the OIU format. For example, if the OIU is initially configured as BC on a particular bus but an OIU format change requires the OIU to be an RT on that bus, the OIU will continue to poll devices on that bus as a BC unless the bus is reconfigured to be an RT via a configuration command prior to the format change.

8.9 RECONFIGURATION DATA TABLES

The OIU reconfiguration data tables reside in an Electronically Erasable Programmable Read Only Memory (EEPROM) and are loaded pre-flight for a specific mission. The purpose of the tables is to provide the OIU firmware with flight specific information concerning the following:

a. OIU hardware connectivity to external devices

b. Command and data paths to external devices

c. Mil-STD-1553 transaction attributes

d. OIU status parameter specifications

e. Data conversion specifications

f. OIU error log dump specifications

g. OIU-to-PDI telemetry frame construction

8.10 OIU CONTROL AND CONFIGURATION

8.10.1 Power ON/OFF

The only function the crew is required to perform, based on Flight Plan call out, is OIU power-up and power-down in the OIU Activation and Deactivation procedures (usually located in the Orbit Operations Checklist, Flight Supplement (OOCL, FS)) since no command is provided for this capability. On the specified standard switch panel (normally SSP1) the crew selects the primary OIU 1 (or 2). On the same panel a talkback shows if the OIU is OFF (barberpole) or which OIU is active (UP = OIU1; DN = OIU2). A label is provided on the panel for crew insight. (Figure 8-7)

OIU Activation

This three digit number is the OIU format
255 is the default format

OIU ACTIVATION

NOTE:
√ MCC that steps 1 & 2 may not be reqd.

1. Load PCMMU/PDI (_/ config 760) for OIU default mode.

2. Power on PSP 1(2)

A1L _/ S-BD PL CNTL – CMD
PWR SYS – 1(2)
_/ SEL – PSP
_/ CNTL – PNL/CMD

SM 62 PCMMU/PL COMM

CRT I/O RESET PSP 1(2) – ITEM 6(7) EXEC (*)

3. Power on OIU 1(2)

SSP1 OIU – OIU 1(2) ON
_/ tb – UP (DN)

OIU DEACTIVATION

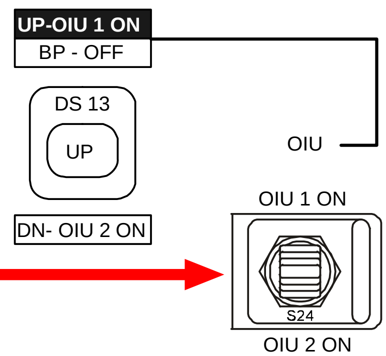
NOTE:
_/ MCC for OIU ops complete.

1. Possible 'S62 PDI DECOM FAIL' msg

SSP1 OIU – ctr
_/ tb – bp

2. MCC will config PCMMU and PDI as reqd.

CONFIG	DECOM	FMT	INPUT	USE
760	1	30	4	SSV(25.6k)*
OIU H&S	2	9	5	TCS2*
TCS/SSV	3	5	1(2)	OIU 255 (Only)*
	4	--	--	
(PRIME)	5-FPM	502		
TFL 184				H-H-H**



SSP 1

USA005368_017

Figure 8-7. OIU Activation

The OIU performs a Power On Self-Test (POST) immediately after power is applied to the unit to test for address, bus, and illegal instruction errors. After POST, the OIU will enter flight mode and begin application initialization, which includes the following steps: reading the reconfiguration data; Initializing the OIU BIAs; constructing the 100ms BC frame table for each BC bus; OIU time initialization; and OIU & ISS synchronization. From a crew/operations perspective, once the application initialization is complete, the default health and status format #255 is active until another format is loaded.

Note: Unless the PDI DFL/FPM is loaded to support OIU format #255, the format itself is visible only to the crew on SPEC 212.

8.10.2 Configuration Change

Operationally, both format and configuration data changes are commanded by MCC, specifically the Instrumentation and Communications Officer (INCO) team, although the crew may load OIU Format/Configurations changes using SM SPEC 212 (Figure 8-8), and Flight Specific Orbit Operation Checklist procedure (Figure 8-9).

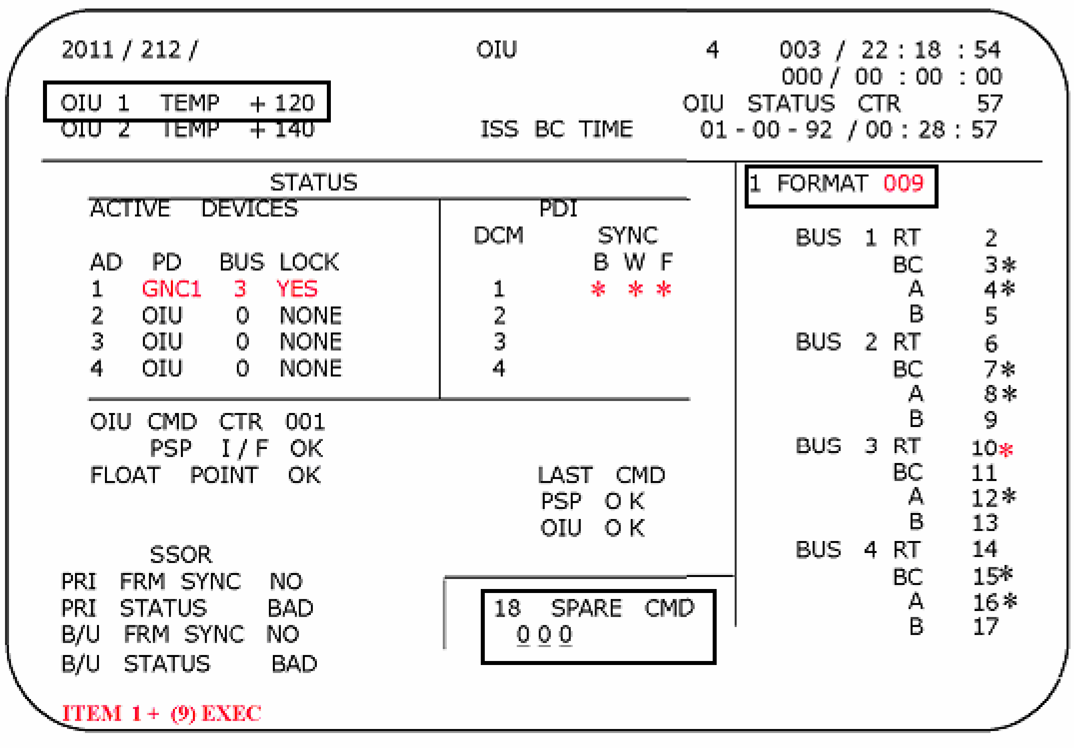


Figure 8-8. SPEC 212

PDI DECOM Formats, Inputs, Use
Sample - CONFIG 780

CONFIG	DECOM	FMT	INPUT	USE
780	1	6	1,2	OIU9(7C)*
MPLM checks	2	27	4	SSV (2)*
Undocked	3	--	--	--
	4	--	--	--
(PRIME)	5-FPM	501		
TFL 199				H-H-H*

•* OI-GNC-SM, Orbiter Downlist Data Rates (High or Low)
•** # in OIU# (#) represents the OIU format and data type
•*** # in SSV (#) represents the SSV Out Rate sw selection

Figure 8-9. Configuration 780

ON SM SPEC 212, the format is changed using ITEM 1 + (format #) EXEC. Configuration Commands may be executed using ITEM 18 (action #, seen in FDF). Bus mapping may be changed using the corresponding ITEM entries for the RT/BC for a particular Bus. In this example, OIU 1 is powered (OIU 1 temperature is not 140°), and the interface between OIU 1 and PSP 1 is established with an ITEM 6 on SPEC 62. MCC must uplink a configuration message for the PSP to process commands sent to the OIU. The crew can change the ISS bus to be the GNC-1 primary on LB-ORB N2-1 (OIU Bus #3) by doing the following.

1. Change active device to GNC-1 → ITEM 18 + 1 4 EXEC
2. Change/select Bus 3 for active bus → ITEM 18 + 1 6 EXEC
3. Select/Make Bus 4 BC, then Bus 3 RT → ITEM 15 EXEC, ITEM 10 EXEC
4. Load/Reload Format → ITEM 1 + 9 EXEC >>

In this configuration, OIU 1 receives data from ISS GNC-1 MDM. A corresponding PCMMU TFL and PDI DFL and FPM load is required for MCC to receive the telemetry.

The PL COMM MALFUNCTION POINTS drawing and OIU/PL COMM malfunction procedures, both located in the ISS Assembly Operations Handbook, show flight specific OIU interfaces and malfunction recovery procedures.

Questions

1. OIU stands for:

    a. Orbiter Intercommunications Unit

    b. Operational Interface Unit

    c. Orbiter Interface Unit

2. The OIU provides ____ interfacing with ISS-type devices.

    a. Voice and television

    b. Command and telemetry data

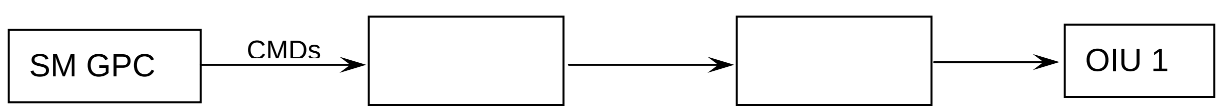
    c. Voice, command, telemetry, and television

3. T/F - The OIU provides the translation functions between Orbiter P/L Comm system and ISS C&DH devices using the Military Standard 1553B protocol.

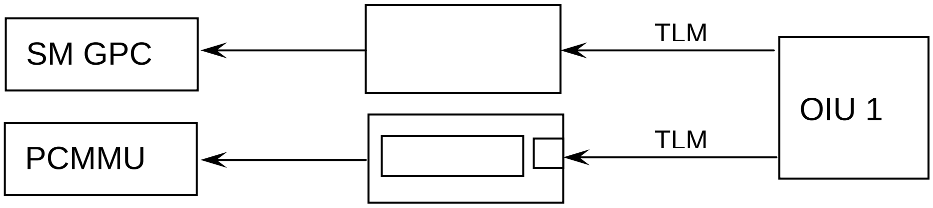
4. The OIU receives and routes commands from the ______________ and provides data to the _____________ from MS1553B devices like MPLM and ISS C&DH (GNC MDMs).

5. _________ OIUs are flown and located under panel L11 with the crew interface switches located on the Standard Switch Panel (SSP).

6. Assuming OIU 1 is the active unit, fill in the command path LRUs from the SM GPC to the OIU.



7. Assuming OIU 1 is the active unit, fill in the telemetry data path LRUs from the OIU to the PCMMU or SM GPC, respectively.



8.

CONFIG	DECOM	FMT	INPUT	USE
780				
	1	6	1,2	OIU9 (7C)*
MPLM checks	2	27	4	SSV (2)*
Undocked	3	--	--	--
	4	--	--	--
(PRIME)	5-FPM	501		
TFL 199				H-H-H*

a. In the above configuration, the OIU format number is ____, and OIU sends its data to DECOM _____.

b. For MCC to receive the telemetry, TFL ______ and FPM ______ must be loaded.

APPENDIX A ACRONYMS/ABBREVIATIONS

A/G	Air-to-Ground
AUX	Auxiliary
BIA	Bus Interface Adapters
B/U	Backup
BC	Bus Controller
BCE	Bus Control Element
BOT	Beginning of Tape
BSY	Busy
BYP	Bypass
C/L	Checklist
C&DH	Command and Data Handling
CMD	Command
COH MODE	Coherent Mode
COMM	Communications
CPLT	Complete
DECOM	Decommutator
DEMOD	Demodulator
DFL	Decommutator Format Load
DOD	Department of Defense
EEPROM	Electronically Erasable Programmable Read Only Memory
FDA	Fault Detection Annunciation
FDF	Flight Data File
FF	Flight Forward
FM	Frequency Modulation
FMSP	Frequency Modulation Signal Processor
FMT	Format
FPM	Fetch-Pointer-Memory
FREQ	Frequency
FS	Flight Supplement
FWD	Forward
GCIL	Ground Command Interface Logic
GNC	Guidance, Navigation, and Control
GPC	General Purpose Computer
GSE	Ground Support Equipment
HDR	High Data Rate
HRDA	High Rate Data Assembly
Hz	Hertz

I/O	Input/Output
ICC	InterComputer Communications
ID	Identification
IFM	In-Flight Maintenance
INCO	Instrumentation and Communications Officer
INCP	Incomplete
INTRG	Interrogator
IRIG-B	Interrange Instrumentation Group B
ISS	International Space Station
KuSP	Ku Signal Processor
LDR	Low Data Rate
LHC	Left-Hand Circular
LRU	Line Replaceable Unit
MAL	Malfunction
MCC	Mission Control Center
MDM	Multiplexer/Demultiplexer
MHz	Megahertz
MMU	Mass Memory Unit
MOD	Modulation Modulator
MPLM	Multipurpose Logistics Module
MULT	Multiple
NASA	National Aeronautics and Space Administration
NSP	Network Signal Processor
OF	Operational Forward
OI	Operational Instrumentation
OIU	Orbiter Interface Unit
OOCL	Orbit Operations Checklist
ORU	Orbiter Replaceable Unit
OUT	Output
PCMMU	Pulse Code Modulation Master Unit
PCS	Payload Control Supervisor
PDI	Payload Data Interleaver
PF	Payload Forward
PI	Payload Interrogator
PL	Payload
PM	Phase Modulation
PNL	Panel
POST	Power On Self-Test
PPP	Payload Patch Panel

PROM	Programmable Read-Only Memory
PSP	Payload Signal Processor
PTB	Payload Timing Buffer
RAM	Random Access Memory
RCD	Record
RCVR	Receiver
RDY	Ready
RF	Radio Frequency
RHC	Right-Hand Circular
RJCT	Reject
RT	Remote Terminal
SM	Systems Management
SPAS	Shuttle Pallet Satellite
SPEC	Specialist Function
SSOR	Space to Space Orbiter Radio
SSP	Standard Switch Panel
SYNC	Synchronization
T-0	Time Zero
TEC	Time Executable Command
TFL	Telemetry Format Load
U/L	Uplink
UMB	Umbilical
XMTR	Transmitter
XMIT	Transmit

APPENDIX B ANSWERS

Section 1.0

1. (c) Commands may be uplinked from the ground to the orbiter through the Ku-band or S-band system. (p. 1-1)

2. (a) The PSP modulates commands onto a subcarrier. (p. 1-1)

3. (b) The PSP makes the decision between the RF or hardline command path. (p. 1-1)

4. (a) Telemetry is first demodulated from the main carrier by the PI. (p. 1-2)

5. (a) The hardline command path is NSP to FF MDM to GPC to PF MDM to PSP to PL UMB to PL. (p. 1-1)

6. (b) The RF command path is NSP to FF MDM to GPC to PF MDM to PSP to PI to PL. (p. 1-1)

7. (c) The RF telemetry path is PL to PI to PSP to PDI to PCMMU. (p. 1-2)

Section 2.0

1. I/O must be reestablished and the configuration message must be reloaded in order to regain use of the PSP after a power cycle. (p. 2-2)

2. No. If I/O was established, but the configuration message was lost with RF PL, would SPEC 62 show "YES" for BIT/FRAME SYNC. (p. 2-3)

3. No. The PSP can load a configuration message without having I/O established with the SM GPC. (p. 2-2)

4. PSP BIT/FRAME SYNC data are sent to SM SPEC 62 through the PF MDM. (p. 2-5)

5. If the SELECT switch on panel A1L is moved from BOTH to the INTRG position, the LRU that gets turned OFF is the PSP1 (assume SYSTEM switch is on 1). (p. 2-6)

6. (c) If the PSP power is turned off, the BIT and FRAME SYNC on SPEC 62 will read blank. (p. 2-6)

7. (a) The PSP CMD OUTPUT switch will direct commands to the PI or the PL UMB. (p. 2-3)

Section 3.0

1. (a) The PHASE LOCK Field on SPEC 62will read YES if the payload transmitter/receiver unit is locked with an RF PL. (p. 3-6)

2. (a) The PI power is turned OFF, the PI status field on SPEC 62 will be blank. (p. 3-5)

3. The <u>FREQ</u> <u>SWEEP</u> switch on panel A1L will help a fixed payload receiver lock onto the PI carrier signal. (p. 3-2)

4. The FREQ SWEEP switch on panel A1L may help the PI receiver lock onto the payload carrier signal only if the payload transmitter/receiver unit is in the <u>coherent</u> mode. (p. 3-7)

5. If MOD is turned off on panel A1L, then the payload receiver will still be able to achieve BIT SYNC (no) and LOCK (yes). (p. 3-6)

Match the letters with the numbers:

1. (f) "BOTH" - PSP on and PI on (p. 3-5)

2. (d) "INTRG" - PI on (p. 3-5)

3. (b) "FREQ SWEEP" - changing carrier frequency (p. 3-2)

4. (a) "MOD" - command or idle pattern modulation data (p. 3-1)

5. (c) "CHANNEL" -000-999 (p. 3-5)

6. (e) "XMTR PWR" - LO, MED, HI (p. 3-2)

Section 4.0

1. (a) If there is a power loss to the PDI, the format display on SPEC 62 cannot be trusted. (p. 4-4)

2. Input 6 of the PDI is reserved for the PSP (RF) input. (p. 4-1)

3. DFL, FPM, and switch matrix inputs are loaded from the SM GPC to the PDI through the PL 1 bus interface. (p. 4-2)

4. (c) PDI inputs 1 through 5 are reserved for PL UMB inputs. (p. 4-1)

5. (d) The PDI RAM stores data going to the SM GPC displays. (p. 4-2)

6. (c) The PDI toggle buffer stored data going to the ground. (p. 4-4)

Section 5.0

1. (d) ITEM 10 + XX EXEC will select the DFL/FPM format XX. (p. 5-2)

2. Yes. ITEM 11 EXEC will load the selected format into the chosen decommutator. (p. 5-2)

3. Yes. During an ITEM 11 EXEC, RUN will appear beside the LOAD, and BSY will appear beside the SM COMM BUFF. (p. 5-2)

4. The TFLs and DFLs may be correlated by the configuration number. (p. 5-1)

5. Yes. The FPM load is treated the same as a decom load. (p. 5-2)

6. The LOAD PDI DECOM FORMAT procedure is in the Flight Supplement section of the Orbit Ops C/L. (p. 5-1)

7. (b) ITEM 12 + X EXEC and ITEM 13 EXEC loads inputs into the switch matrix. (p. 5-2)

Section 6.0

1. SM SPEC 62 is used to enable the FDA system. (p. 6-1)

2. Item number 15 will toggle the FDA asterisk for decom 2. (p. 6-1)

3. No. If the FDA is not enabled and decom loses lock, the message and the arrow will still appear. (p. 6-1)

4. Yes. Triggering the FDA does not necessarily mean the decom has failed. (p. 6-1)

Section 7.0

1. (d) The three messages, S62 BCE BYP PDI, S62 PDI DECOM FAIL, and S62 BCE BYP PL, isolate the problem to the PDI. (p. 7-4)

2. Yes The PI field on SPEC 62 shows a complete blank if the PI power is turned off. (p. 7-4)

3. False. After PI power is turned off, the PSP BIT/FRAME SYNC field goes blank also. (p. 7-4)

4. (a) A PSP power failure would produce the two messages, S62 BCE BYP PSP 1(2) and S62 PDI DECOM FAIL, and an up arrow beside the decommutator with input 6 assigned to it. (p. 7-2)

5. A PSP power failure would also produce a loss of PSP BIT and FRAME sync data for RF PLs and “M” by the PSP I/O reset. (p. 7-2)

6. Yes. Using the downstream method, you should start at the PCMMU and trace the payload telemetry path. (p. 7-1)

7. No. A PSP-PF MDM interface failure causes an S62 PDI DECOM FAIL message and an up arrow by the decommutator which lost lock. (p. 7-8)

8. For a PSP-PDI failure, the PSP BIT and FRAME SYNC on SPEC 62 reads YES. (p. 7-5)

Section 8.0

1. OIU stands for:

    c. Orbiter Interface Unit

2. The OIU provides ____ interfacing with ISS-type devices.

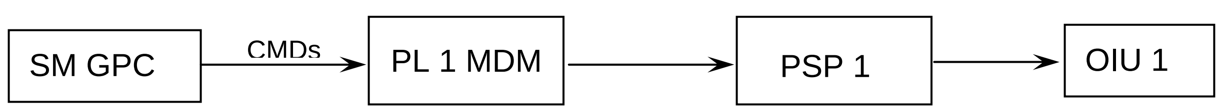
    b. Command and telemetry data

3. T The OIU provides the translation functions between Orbiter P/L Comm system and ISS C&DH devices using the Military Standard 1553B protocol.

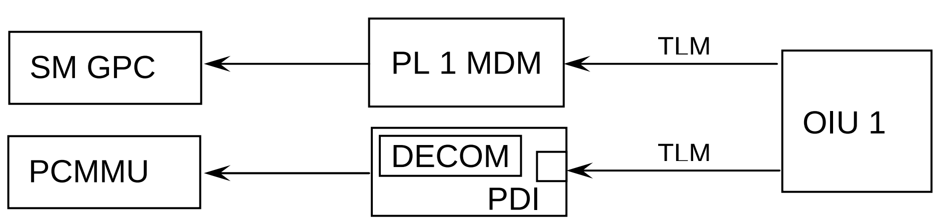
4. The OIU receives and routes commands from the PSP and provides data to the PDI from MS1553B devices like MPLM and ISS C&DH (GNC MDMs).

5. TWO OIUs are flown and located under panel L11 with the crew interface switches located on the Standard Switch Panel (SSP).

6. Assuming OIU 1 is the active unit, fill in the command path LRUs from the SM GPC to the OIU.



7. Assuming OIU 1 is the active unit, fill in the telemetry data path LRUs from the OIU to the PCMMU or SM GPC, respectively. (p. 8-5)



8.

CONFIG	DECOM	FMT	INPUT	USE
780				
	1	6	1,2	OIU9 (7C)*
MPLM checks	2	27	4	SSV (2)*
Undocked	3	--	--	--
	4	--	--	--
(PRIME)	5-FPM	501		
TFL 199				H-H-H*

a. In the above configuration, the OIU format number is 9, and OIU sends its data to DECOM 1. (p. 8-10)

b. For MCC to receive the telemetry, TFL 199 and FPM 501 must be loaded. (p. 8-11)

APPENDIX C PCMMU/PL COMM DISPLAY

Refer to Figure C-1.

C.1 SM COM BUFF XXX

This field is used to relay the status of the common buffer in the GPC. The buffer is a temporary storage area for TFLs and DFLs traveling from the MMU to either the PCMMU or the PDI, respectively. RDY means ready and BSY means busy. If a load request is done while BSY is displayed, there is a load reject.

C.2 BITE WORD XXXX

This field displays the PCMMU status word in hexadecimal format.

C.3 SEL FXD 1 X

An asterisk is displayed in this field after an ITEM 1 EXECUTE. The asterisk indicates the telemetry formatter is operating from fixed programmable read-only memory (PROM) instructions. This is also displayed for a newly powered/selected PCMMU.

C.4 PGM 2 X

An asterisk is displayed in this field after an ITEM 2 EXECUTE. The asterisk indicates the telemetry formatter from the TFL loaded into the HDR RAM.

C.5 PGM ID 64 XXX

This field displays the LDR TFL ID number. All ID numbers displayed in this field are below 129.

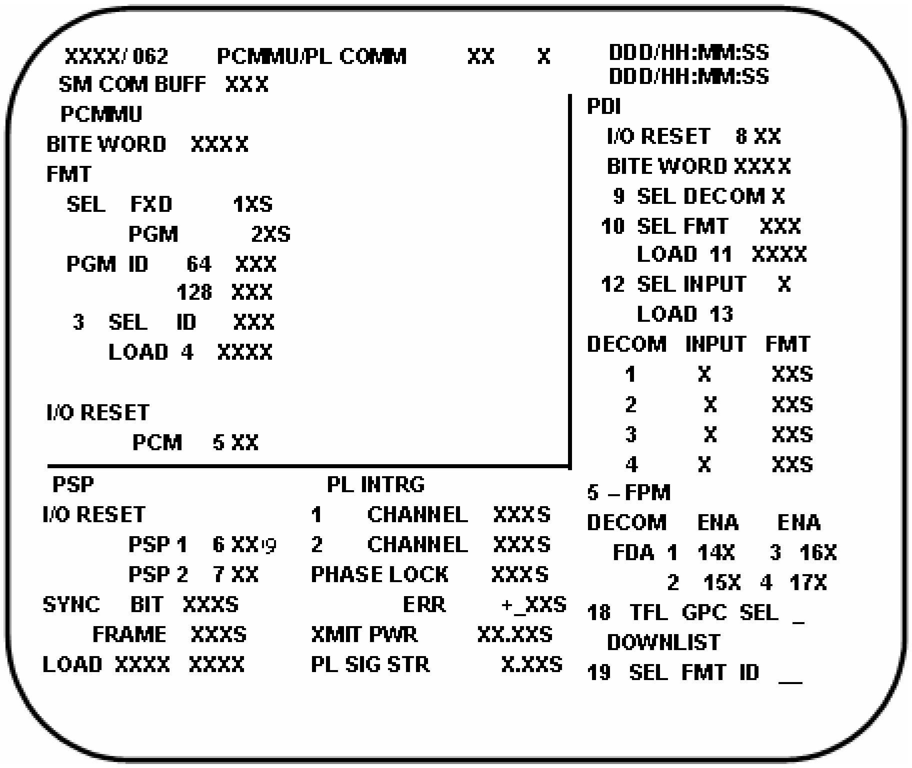


Figure C-1. PCMMU/PL COMM display

C.6 128 XXX

This field displays the HDR TFL ID number. All ID numbers displayed in this field are above 129. For the TFLs burned into the PROM, 129 is the reserved ID number.

C.7 3 SEL ID XXX

ITEM (3) + XXX EXECUTE selects the TFL ID number (XXX in this example). Afterwards, the ID is only displayed, not loaded.

C.8 LOAD 4 XXXX

ITEM 4 EXECUTE causes the selected TFL ID to be loaded into the HDR or LDR RAM. During the load, RUN is displayed in the field. After the load is finished, the field displays CPLT.

C.9 I/O RESET PCM 5 X

An asterisk is displayed in this field after an ITEM 5 EXECUTE. The asterisk indicates that I/O communication has been established between the SM GPC and the PCMMU.

C.10 I/O RESET PSP1 6 XX OR PSP2 7 XX

An asterisk is displayed in either field after an ITEM 6 or 7 EXECUTE. The asterisk indicates that I/O communication has been established between the SM GPC and the PSP (1 or 2).

C.11 SYNC BIT XXX

This field displays YES if the PSP has bit sync with payload telemetry stream. The field displays NO if the PSP does not have lock. The filed is blank if the PSP power is turned off or it displays M's beside static data if the PF MDM has a power failure.

C.12 FRAME XXX

This field displays YES if the PSP has frame sync with the payload telemetry stream. Otherwise, it displays NO.

C.13 LOAD XXXX XXXX

The first field tells the status of the command load. The possible status is RJCT (reject), INCP (incomplete), or blank (nominal).

The second field displays the source of the command being processed: time executed command (TEC), payload control supervisor (PCS), ITEM, uplink (U/L), guidance, navigation, and control (GNC), MULT (multiple source). The field is blank for nominal operation.

C.14 1 CHANNEL XXX OR 2 CHANNEL XXX

This field shows the currently selected RF channel for PI 1 or 2.

C.15 PHASE LOCK XXX

This field tells if the PI receiver has carrier lock on the payload transmitter carrier.

C.16 ERR + XX

This field shows the tracking error in the PI receiver. This may also be referred to as loop stress.

C.17 XMT PWR XX.XX

This field displays the three ranges of transmitter power output: low (2.5 to 7.9 milliwatts), medium (0.5 to 1.6 watts), and high power (0.0 to 10.6 watts).

C.18 PL SIG STR X.XX

This field displays the received signal strength of the payload transmitter carrier. The signal strength is shown in volts.

C.19 I/O RESET 8 XX

ITEM 8 EXECUTE establishes the I/O communication between the SM GPC and the PDI. I/O must be established before any data may be passed to or from the PDI.

C.20 BITE WORK XXXX

This field displays the PDI bite status word 2 in hexadecimal format.

C.21 9 SEL DECOM X

ITEM (9) + X EXECUTE selects one of four decoms or the FPM for the format and input loads.

C.22 10 SEL FMT XXX

ITEM (10) + XXX EXECUTE selects the DFL ID number and then displays it.

C.23 LOAD 11

ITEM (11) EXECUTE loads the DFL format into the selected decom or FPM.

C.24 12 SEL INPUT X

ITEM (12) + X EXECUTE chooses an input to the assigned to the current decommutator selection.

C.25 LOAD 13

ITEM (13) EXECUTE loads the decommutators assigned input into the switch matrix.

C.26 DECOM INPUT FMT

The input and format assigned to each decommutator are displayed in these fields. The FPM is treated like a decommutator in this display (5-FPM).

C.27 DECOM FDA ENA

This field allows the FDA system to be toggled ON or OFF for any for the four decoms. An asterisk beside a decommutator number (1 through 4) means the FDA is enabled. No asterisk means the FDA software is inhibited. The item numbers are 14 through 17.

C.28 18 TFL GPC SEL X

ITEM (18) + EXECUTE selects the GPC which loads a TFL off the MMU. This item is used only in OPS software.

APPENDIX D PANEL A1L SWITCHES

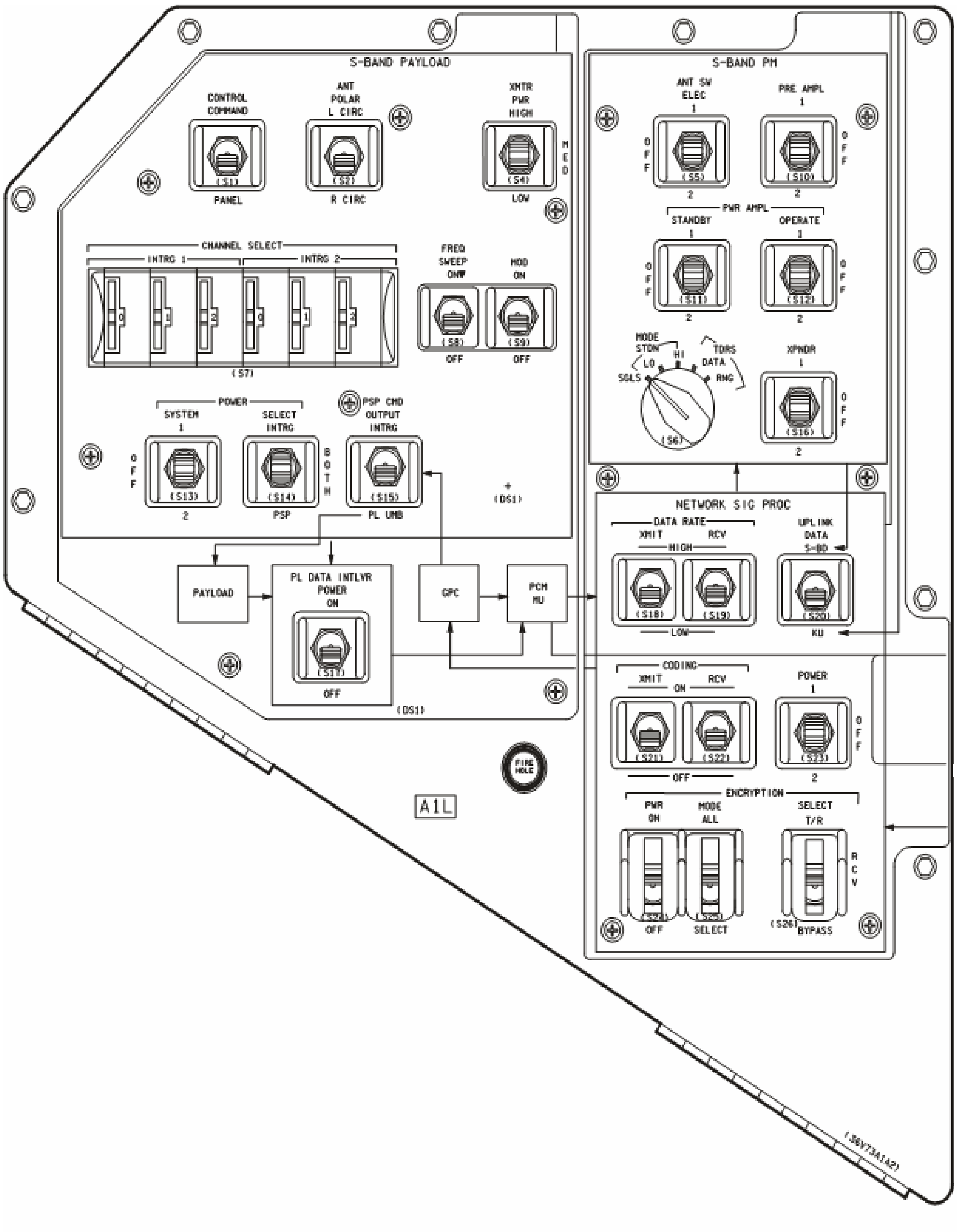


Figure D-1. Panel A1L

CONTROL

COMMAND	Allows the PL COMM system to be configured by command.
PANEL	Allows the PL COMM system to be configured by panel A1L.

ANT POLAR

L CIRC	Selects the left-hand-circular polarization pattern for the antenna.
R CIRC	Selects the right-hand-circular polarization pattern for the antenna.

XMTR PWR

HIGH	Selects the high power output for the PI transmitter (0.0 to 10.6 watts).
MED	Selects the medium power output for the PI transmitter (0.5 to 1.6 watts).
LOW	Selects the low power output for the PI transmitter (2.5 to 7.9 milliwatts).

CHANNEL SELECT

INTRG 1	Thumbwheels select the PI 1 channel (transmit and receive frequencies).
INTRG 2	Thumbwheels select the PI 2 channel (transmit and receive frequencies).

FREQ SWEEP

ON	Moves the transmitter carrier back and forth within a specified range.
OFF	Frequency sweep is off.

MOD

ON	Command or idle pattern modulation turns ON.
OFF	Command or idle pattern modulation turns OFF.

POWER

SYSTEM

1	Selects PI and PSP 1 (PSP 1 is hardwired to PF MDM 1).
2	Selects PI and PSP 2 (PSP 2 is hardwired to PF MDM 2).

SELECT

INTRG	Selects the PI chosen by the SYSTEM switch. The PSP is not selected in this position.
BOTH	Selects both the PI and the PSP chosen by the SYSTEM switch.
PSP	Selects only the PSP chosen by the SYSTEM switch. The PI is not selected in this position.

PSP CMD OUTPUT

INTRG	The PSP selects the PI as the command output.
PL UMB	The PSP selects payload umbilical as the command output.

PL DATA INTLVR POWER

ON	Turns the PDI power on.
OFF	Turns the PDI power off.